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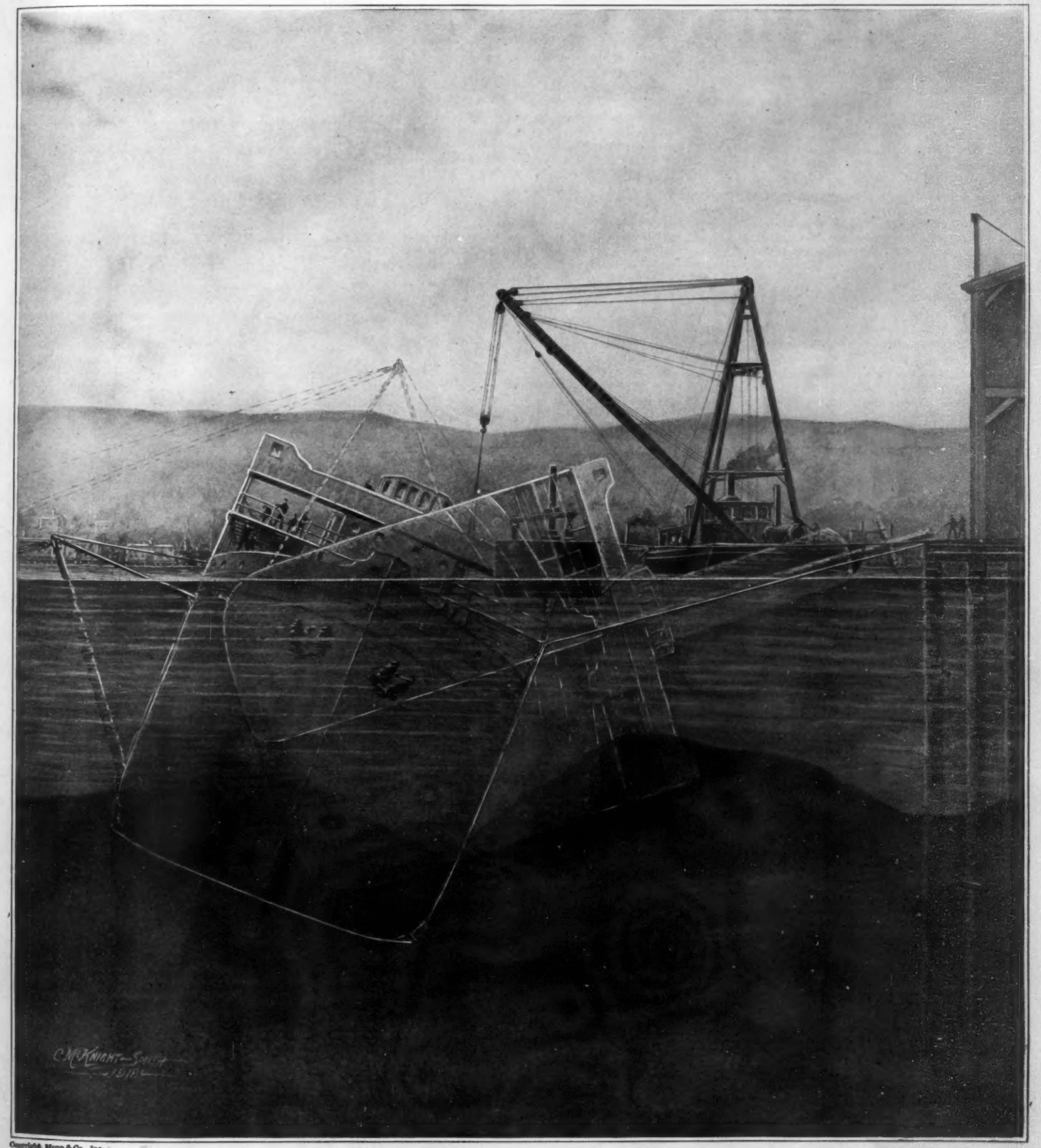

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On April 25th of this year, the "St. Paul" capsized at Pier 60, North River, New York, and sank until her port bilge was 32 feet in the mud and 54 feet below low water. She was rolled over by cables and hoisting engines, assisted by lifting pontoons, to the position shown above. Then she was pumped out, ballasted and floated September 11th. On September 27th she was turned over to her owners. **[See page 314]**

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Our Army in Forest and Factory

IN northern New England there is a demand for at least 25,000 men to get out airplane spruce and other timber for war work. The munitions plants of four Atlantic states are short, in the aggregate, 83,000 men. Projects at Norfolk, Va., and at Fayetteville, N. C., require each 10,000 more men than they have been able to get. The labor shortage at the great Charleston, S. C., Port Terminal is about 5,000; at the Brunswick, Ga., picric acid plant it is 3,000; at the atmospheric nitrogen plant of Muscle Shoals, Ala., with its attendant industries, 20,000; at Camp Pike and the Little Rock picric acid plant, 10,000. Two new nitrate plants nearing completion in Ohio will require 40,000 men for capacity operation and one in West Virginia 6,000.

The War Department has laid out a formidable program. Apparently this has been done in reckless disregard of the fact that labor to carry it out is not visible. In reality the ambitious projects have been put under way because the Army places complete confidence in the ability and the will of the American people to drop everything else and get effectively behind the schedule that has been adopted for winning the war. But let us remember that success lies not in mere hurrahing and reiterating our determination; it lies in finding the men who are needed, and in no other direction.

Now this business of getting thousands of men out of old places and into new is not a thing that can be done overnight. It is just like so many other of our war-time tasks. Time and again we have seen a job which apparently was not progressing satisfactorily, only to take on tremendous impetus and violate all speed laws in rushing to successful conclusion. The reason for this is that preparation and preliminary work are usually long drawn out and at the same time without visible results. It has been said that if one of our Allies has a monster job on his hands which must be completed in 12 hours, he will pitch in and work at top speed on it for 12 hours—and get it finished; but that an American in the same situation will spend 11 hours inventing a new machine with which he will be able to do the job in the hour that remains. To the bystander, those hours of waiting are anxious ones; they are none the less necessary.

Referring this simile to the job of finding men for our multitudinous war industries, we find that the Department of Labor, the American body to which this job pertains, has just about passed through its 11 hours of inventive effort. While it has been perfecting the machine with which it proposes to solve the problems before it, the situation has been left to itself and seems to have got somewhat out of hand; but with the machine revealed to us now, we may look with confidence to vastly improved conditions as a result of its successful operation.

The United States Employment Service is the foundation upon which this machinery is mounted. Community Labor Boards throughout the country have been entrusted with the duty of combing out non-essential industries for the various quotas of men—quotas which have been arrived at after the most careful weighing of all considerations. Other machinery has been created whereby the transfer of women can be regulated for the best results, alike to the women, to the men whom they replace, and to the industry concerned. The means of coöperating with the draft boards and making their rulings accord with the industrial factors in the case have been developed. The unsuspected degree in which women are available for a wide variety of industrial occupations has been properly advertised. Finally, the will to take drastic steps, and the public opinion to back up such steps, where non-essential industries fail to give up their due proportion of men or where essential industries and essential men in those industries fail to make the necessary exemption claims, is rapidly being crystallized. On the whole, we have every reason to be encouraged with the progress made. Our industrial problems are not solved; there is no room for a false feeling of security; but we are finding the safe way out.

National Characteristics

CUSTOM has dictated, these many years, that we recognize a national characteristic as pertaining to each of the major nationalities. The Frenchman, according to this tradition, is an unstable creature of impulse; the Briton is a direct antithesis, holding indefinitely and without emotion to fixed and immutable ideas; the German is a thorough and phlegmatic machine; the Latin-American is the personification of procrastination; the Russian is a strange and incomprehensible combination of child-like simplicity, introspective genius and fatalism.

The historian and the anthropologist join in warning us against this viewpoint. They tell us that the French nation matches in immutability anything the human race has produced. They point out that France's government, while taking various external forms, has in substance remained unaltered for a century; that for generations the Frenchman has held faithfully to the vast amounts of red tape that encircle all his activities. They make it equally clear that England has changed her fundamental ideas of government, changed her foreign policies, changed her friends and her enemies, changed her mind upon every public question, more frequently than any other nation on the records. If they could command our ears, they would doubtless demonstrate that the other nations too are maligned by the traits which we have been accustomed to ascribe to them. And they would conclude by denying categorically the existence of national characteristics.

Nevertheless, however loudly these iconoclasts may lift up their voices, they will not prevail. The average citizen is firmly convinced that the Frenchman is as he is pictured, that the Englishman is indeed a bulldog, and all the rest of the familiar tale. And the American—what of him? Has he, too, a national characteristic?

If he has, it is not to be found springing from any cause connected with racial extraction; America is of far too conglomerate origin for anything of the sort. The only ground upon which an American national characteristic could conceivably be postulated is that of environment. Are American conditions sufficiently unique and sufficiently emphasized to produce, upon us who are born or brought into them, a common reaction?

The answer to these queries is not so obscure as might be anticipated. Our environment is described in the very terms which describe our racial and social make-up. We are heterogeneous, conglomerate, a melting pot. The European is born into a given set of conditions, determined by the social class to which he belongs; he never gets out of that class, or away from those conditions. At home or in school or in business, at work or at play, the same environment surrounds him always. But when Giuseppi, the bootblack's boy, leaves his home in Little Italy for school, he leaves behind him the Italian peasant environment that surrounds him at home and enters another world. When he reaches working age he meets still another set of conditions; in fact, many times in a single day he passes from one world into another. For America is all worlds in one; but unlike other countries of which the same thing could almost be said, there are no barriers between these worlds of ours; all of them are open to every one of us, and most of us live alternately in every one of them.

This constantly shifting environment means a constant adjustment. Every American is constantly called upon to respond instantaneously to new conditions; and it develops in us an adaptability which other nations do not ordinarily possess. The net result is that the American is fast becoming known throughout the world as the man who catches on quickly. No matter how new a proposition is, no matter how different from anything he has ever encountered, the American will attack it with vim and learn all its angles.

We have it on the competent testimony of countless thousands. We have always known it, and prided ourselves in it; but perhaps it has never occurred to us to glorify it to the rank of a national characteristic. But four million Americans in France are going to give it such a prominent place that we can no longer avoid doing this. Already our Allies have marveled at it; under protest and with grave misgivings they have placed in the line American troops whom they considered inadequately trained; and these men have caught on with a rapidity that amazed the French and British. May we not hope that, side by side with the volatile Frenchman and the tenacious Briton and the imperturbable Hollander and the canny, taciturn Scot, the American will take his place as the man who catches on?

Unification of Our Railroad Systems

IN our last issue we reviewed the broader aspects of the policy of the Federal Railroad Administration, and we shall now consider briefly and in more detail the measures which have been adopted to secure the full benefits of the consolidation.

Having in view the greatly increased cost of living, an advance was made in the wages of employees earning $250 a month or less. These advances ranged from 43 per cent on the lowest monthly wage to nothing where the wage was $250 a month; and contemporaneously with this the eight-hour day was adopted for railroad employees. Also, those employed in the mechanical departments, including machinists, boilermakers, blacksmiths, etc., to a total of some 500,000 men, received a substantial advance on a basic rate of 68 cents per hour. To meet this increase, freight rates were advanced 25 per cent and passenger rates were raised to a minimum of three cents per mile. Thus far no decline has been noticeable in the case of passenger traffic, which actually shows an increase in the industrial districts and those serving the military camps.

Since under unified control there is no longer any competition for freight and passenger traffic, the Director General ordered that solicitation of traffic and special exploitation of passenger rates should be discontinued. The soliciting officers of the various railroads have been relieved from duty or assigned to employment with the operating departments, and the separate ticket offices have been consolidated. The total saving resulting from this policy will reach $23,566,633.

Under the system of separate and competitive operation there was formerly a distinct surplusage of elaborately equipped passenger trains, which in many cases started and arrived at the same time with the result that some of them were but half full. Many of these unnecessary trains have been eliminated; in the territory west of Chicago and the Mississippi passenger trains having an aggregate travel of 21,000,000 miles have been dispensed with, and in the Eastern District a total of 26,420,000 miles of travel have been saved. Railroad tickets between points covered by one or more roads are honored by any of the roads.

Another important feature of unified control is that it has become possible to make common use of the same terminals by railroads formerly in competition and using separate terminals. A conspicuous example of this is the present use of the Pennsylvania terminal in New York for through trains of the Baltimore and Ohio between Washington and New York. And in this case, as in many others, trains leave at successive hours instead of at the same time. Consequently, fewer trains are necessary, and since a ticket between Washington and New York is good over either road, there is a train available nearly every hour, and it is scarcely necessary to consult the timetables.

On the principle that a straight line is the shortest distance between two points, well graded routes for the transportation of freight are being developed that will be shorter than those previously in use. One of these new routes has saved 500 miles. To another a saving of 880 miles is to be credited; and several others show savings of from 103 to 234 miles. To give an example of this economy—during a period of 60 days some 9,000 cars were so rerouted as to effect a saving of 195 miles for each car.

Another important innovation is the standardization of freight cars and locomotives. Prior to the war over 2,000 different styles of freight cars and nearly as many different types of locomotives were to be found on American railroads, nearly every company having its own specifications for its cars and engines. A start toward complete standardization has been made by adopting 12 standard types for freight cars. Also, it has been decided that hereafter only six types of locomotives of two weights each shall be purchased. Any master mechanic will appreciate what it means when it is understood that the parts of these various types of locomotives and freight cars will be interchangeable.

A most important achievement has been the consolidation of the four more important express companies, under the name of the American Railway Express Co., which will conduct express business on all the lines of the Federal railway system. Fifty and one-quarter per cent of the gross revenue of this company is to be paid to the United States Railroad Administration for the transportation of express matter. The balance of the earnings, after paying expenses and five per cent on its capital stock, if earned, will be divided between the express company, the capital railroad administration and a guaranty fund.

Results thus far secured are gratifying. In April, 1917, the revenue ton-miles of 94 per cent of railroads having an operating income in excess of $1,000,000 per year was 31,464,837,365 miles. In April, 1918, it had risen to 34,250,247,814. This is an increase of 8.9 per cent. The number of freight cars in service had increased by 5.1 per cent. The number of tons hauled per train increased 6.9 per cent. The increase in the individual car load was 14.4 per cent. The revenue ton-miles for freight locomotives showed an increase of 7.9 per cent. During the first six months of Federal operation, the increase in coal carried by the railroad was about 22,000,000 tons.

Very gratifying is the last statement of the Director, that officials and employees have worked with such loyalty and zeal to accomplish what has already been done that it is a genuine pleasure to make acknowledgement of their splendid work, it is a constant satisfaction to be associated with them.

Aeronautics

An Extraordinary Accident is reported by the *Daily Mail* correspondent in a recent issue of that London newspaper. He says a Belgian airman, Gheude, who specializes in the destruction of German balloons, was flying above one preparatory to attacking it, when the two balloonists took to their parachutes. The balloon shot up and struck the airplane, and was torn to pieces on the propeller. It sent the plane spinning earthward, but by a miracle the machine righted itself and Gheude landed safely, and saw the balloon in flames in the sky.

The British Independent Air Force.—During the month of June no fewer than 74 raids were carried out by the Independent Air Force, Royal Air Force, over Germany. In all, 61¼ tons of bombs were dropped during these raids. It is worthy of note that the British raids over Germany show a continuous increase in number and in weight of bombs dropped upon important military objectives. The previous best month was May last, when 48½ tons of bombs were dropped by the I. A. F. This excellent work on the part of the Independent Air Force is quite apart from that of the Royal Air Force and the French Air Service.

Parachute Jump from Airplane.—The first successful experiment on record of jumping from a moving airplane with a parachute was recently made by Capt. Sarrat, a French aviator. This intrepid airman leaped from a height of 800 yards with an umbrella some twelve yards in diameter, and landed safely. He was three minutes in the air, suspended from the parachute. Previous to this test numerous experiments were carried out in France with sandbags, and the practicability of the scheme was established beyond reasonable doubt. But it goes without saying, nevertheless, that it required real courage to be the first to risk life and limb in an actual test.

A Royal Flight.—The King and Queen of the Belgians have already been unconventional, but the public had somewhat of a surprise when it became known that their Majesties had crossed over to England in seaplanes to take part in the Royal Silver Wedding celebrations. They arrived off the coast about 6.15 P. M., and came ashore by motor launch. The return journey was made in the same way a week later. The pilot of the Queen's seaplane was Adjutant Boin, a famous swimmer before he joined the Belgian Air Service, while the King's pilot was Lieut. Ortha. A French scouting airplane piloted by Naval Lieut. Noirot acted as escort. During the flight Queen Elizabeth took photographs and asked a number of questions on a slate.

Night Photographs from Airplane.—An Italian invention which permits photographs being taken at night has been submitted to the Signal Corps of the United States Army. According to the men who control the new device, it will soon be possible to take excellent pictures of enemy positions from airplanes flying at a low height on moonlight nights. It is also claimed that the invention can be fitted to motion picture cameras, which would permit the photographing for the screen of much of the fighting in the air, the greater part of which takes place in the early morning hours. Up to the present time the chief obstacles met by the daylight aerial photographers is that the anti-aircraft guns force the fliers to take pictures from a great height, and much of the detail of the enemy lines is therefore lost. It is held, continues *Aviation*, that fliers are in little danger from artillery when flying at night.

Testimony from the Enemy.—"One of the most striking features of the present phase of the war is the superior skill of our airmen," says Reuter's Special Correspondent with the British Army. He states that "an officer pilot who was lately taken prisoner says that this superior skill is fully realized throughout the German army, and is regarded with grave concern. He added that the morale of the enemy air service has become lower than it has ever been, and the quality of the material supplied often shows great deterioration. Many new machines are built of tubing and wire of poor quality, and increasingly frequent mishaps are the result. Damaged machines are sent back into Germany whenever practicable to be patched up, and used in the instructional schools, and this too, is a cause of accidents. This pilot doubted whether 30 per cent of the aspirants who enter the schools ever get to the front, and he says that so great is the shortage of officers that private soldiers are being trained as observers."

The British DeHavilland Four.—Among the newest English long distance patrol airplanes the DeHavilland IV biplane forms one of the most interesting models, states the German aero journal *Luftfahrt*, in describing a captured British machine. For so far very few two-seater designs altogether have been turned out with a 300-horse-power plant, as the British efforts seem undoubtedly to strive at a limitation of the variety of airplane types employed at present. The 300-horse-power motor is of the Rolls-Royce type, having 12 cylinders in two V-shaped rows of six cylinders each. Even though the mounting of the engine is of fundamental importance for the whole fuselage form of an airplane, a standard shape of the body in all airplane types has settled in England pretty independent of the motor, observes the German critic. Though patrol airplanes equipped with 300-horse-power engines have only passed through a short period of development, the DeHavilland IV tractor biplane is yet remarkable in many respects. It appears, too, to have fulfilled the expectations well at the front.

Astronomy

The Royal Observatory of Belgium, at Uccle, near Brussels, is keeping up a certain amount of astronomical work in spite of untoward conditions. The acting director, Prof. Paul Stroobant, is giving weekly popular lectures on astronomy, which are said to be well attended.

Barnard's Runaway Star.—A large number of values have now been published for the parallax of the star in Ophiuchus having the greatest known proper motion, discovered by Barnard in June, 1916. These range from 0.42 sec. to 1.00 sec. A. van Maanen of Mt. Wilson Observatory, adopting a parallax of 0.500 sec., states that the absolute magnitude is 13.17 photovisual and 14.93 photographic; the object is therefore one of the very faintest stars known. (The absolute magnitude of a star is the apparent magnitude it would have if at such a distance from us that its parallax was 0.1 sec.)

Airplane Observation of the Eclipse.—If it develops nothing else of novelty, the recent solar eclipse can fairly lay claim to be the first astronomical event to be observed from an airplane. Although the flight and observation made at Fort Sill, Okla., were not undertaken with any serious scientific object in view, it was at least demonstrated that we may eventually look to the aviator for work of value in connection with eclipses. While most of the undertakings of eclipse time call for a solid foundation which can hardly be looked for even in the plane of the future, the aviator can at least free the astronomer from his complete subjection to clouds and other superficial weather phenomena. We may, therefore, look for more general use of planes in connection with subsequent eclipses.

Weather Records for Eclipse Expeditions.—The experience of some of the observers of the total solar eclipse of last June emphasizes the fact that statistics of cloudiness based on the ordinary official weather observations at certain morning and evening hours are not necessarily applicable to the hour of an eclipse. The expeditions to Russia, in 1914, likewise found that while the mornings and evenings, when the Government weather observations are made, were remarkable for clear skies, cumulus clouds formed every day and reached their maximum about the time of the eclipse, or between 2 and 3 P. M. Professor Campbell, in commenting on these facts, urges that for a few years before each solar eclipse meteorological observations should be made along the path of totality at the eclipse hour, and not merely at the ordinary term hours.

A Fortunate Rift in the Clouds.—The Lick observatory expedition which viewed the total solar eclipse of June 8th last at Goldendale, Wash., had an experience with clouds to which it would be hard to find a parallel in the history of eclipse observations. The sky became completely overcast late on the night of the 7th and remained completely cloudy until midnight of the 8th, except that a small rift occurred at exactly the right time and place to admit a fine view of the eclipse. "The clouds," says Professor Hale, "uncovered the sun less than one minute before the beginning of totality and they again covered the sun a few seconds after the end of totality. The small region of unclouded sky containing the totally eclipsed sun seemed to be absolutely clear, and the bluest sky we had seen during the whole of our residence at the station."

Research Funds of American Observatories.—Although this country is far better provided than any other with large and well-equipped astronomical observatories, the total amount of money available at these institutions for research purposes is relatively small. This fact is well brought out in a report of the Committee of One Hundred of the American Association for the Advancement of Science, published in *Science* of July 26th. Data are given for all the well known observatories of the country. Very few of these observatories are adequately endowed. The net impression one gains from the report is that a great amount of splendid apparatus is yielding only a small part of the scientific results that would be forthcoming if more money were available for operating expenses, purchase of auxiliary instruments, publication, etc. The need of trained assistants is especially urgent.

Does the Aurora Occur at Low Levels?—The question of the altitude of the aurora polaris has been discussed from time to time in these columns, and it has been pointed out that the recent photographic measurements of Störmer and others do not bear out the belief, once generally entertained, that the aurora frequently occurs at low levels in the atmosphere. In a recent letter to *Nature*, Dr. G. C. Simpson, who was a member of the Scott antarctic expedition, describes certain instances in which his fellow-explorers thought they saw auroral beams between their position and Mount Erebus, and hence not far above the earth. In each case, however, he himself was able to observe that this appearance was illusory. In one case bands of moonlight were mistaken for the aurora; in another, the aurora was seen in a patch of clear sky between the mountain and a cloud, which appeared to be a part of mountain; while in a third the alleged auroral beam was a part of a lunar halo. Dr. C. Chree, commenting on Simpson's letter, points out that the Mawson expedition recorded a greater number of apparent cases of aurora at low altitudes, and he thinks that "we are not yet in a position to deny the possibility of the occurrence of the aurora at low levels near the magnetic poles." It is to be hoped that future polar explorers will make special efforts to settle this question and that they will carry out measurements of auroral heights by photography, according to the method of Störmer.

Industrial Efficiency

Scarcity of Copper in Sweden.—We observe that in Sweden experience in regard to scarcity of copper has been generally similar to that of Germany, and early in the present year an order was made that copper must not be used for conductors exceeding 6 sq. mm. in section without a permit from the Executive Committee dealing with the matter. It is understood that zinc is recommended as the most suitable substitute, being found in considerable quantities in Sweden and comparatively well adapted to electrical requirements.

Fuel Facts.—Anyone who is interested in the fuel question, and that includes practically everyone from the home dweller to the large factory owner, should not fail to secure a copy of Fuel Facts, published by the U. S. Fuel Administration. This booklet of over 60 pages contains invaluable information concerning the present fuel situation, as well as important suggestions to fuel users. The work outlines just what the Fuel Administration is doing in order to meet one of the most important questions of the hour. The booklet is free for the asking from the U. S. Fuel Administration, Washington, D. C.

Magnetic Separators for Treating Waste Iron.—According to our well-informed contemporary, *The Electrician* of London, magnetic separators are now being used in Germany for the recovery of scrap iron from many kinds of waste material and rubbish. By the aid of such apparatus, it is stated, a great deal of refuse commonly discarded in the neighborhood of steel and iron works can be made to yield a considerable amount of iron—as much as 50 per cent being obtained from refuse from steel works in some cases. Cupola furnace slag is said to give 5 to 15 per cent, and ordinary workshop rubbish 2 to 10 per cent.

Again, the Fire Hazard.—German spies, I. W. W. agents and Bolsheviki are not as great a menace to this country as the average careless American with his thoughtless handling of matches, cigarettes, and accumulated rubbish, according to the *Weekly Underwriter*. Our indifference to this danger imperils our war progress and helps the Hun. Fire prevention is not a selfish aim: it is a "win-the-war" necessity. The excellent practical suggestion has been made that we begin at once to collect our great war indemnity from Germany by the lesson of conservation the war has brought right home to every man. That is a light in which every man ought to see his present duty. All must do their utmost to make every one realize the situation. An attack en masse upon this insidious national evil must be carried through at once to a victorious end.

Tests on Metal Drills.—A series of experiments conducted by Messrs. Bruce W. Benedict and W. Penn Lukens on the performance of metal drills has been completed by the Engineering Experiment Station of the University of Illinois and the results published as Bulletin 103. One-inch drills of many well-known standard makes and special cast-iron blocks made in the shop laboratories were used. The power required at the drill point for different speeds and rates of feed were recorded by special dynamometers, and the endurance of drills of different designs was studied. The economical helix angle, point angle, clearance angle, speed and feed were determined, and the effects of pilot holes and rounded corners were shown. Copies of this bulletin may be obtained on application to the Engineering Experiment Station, University of Illinois, Urbana, Ill.

The Dust Danger.—The U. S. Department of Agriculture has recently prepared a booklet entitled, "Prevent Grain Dust Explosions and Fires," which contains much valuable information on this form of industrial danger. This booklet, which is free for the asking, sums up the "safety first" aspect of grain elevators and mills and other places subject to the dust explosion danger as follows: "Let us not then, through sheer carelessness, continue to risk the loss of our elevators and mills, with their valuable stores of wheat, flour, and other food products, and the lives of the employees of these plants. Play safe by following these rules—1. Construct the plant of fireproof materials. 2. keep the plant clean and as free as possible from accumulations of dust. 3. Install an efficient dust collecting system. 4. Prevent the use and production of flames and sparks of any kind. 5. Prohibit smoking and carrying of matches. 6. Install some improved system of protection against fire.

Scarcity of Trained Safety Engineers.—According to Mr. L. A. DeBlois, Safety Engineer, E. I. du Pont de Nemours & Co., Wilmington, Del., apathy to the safety movement among engineers in general and the lamentable scarcity of trained safety engineers technically fitted to carry forward the work, are the greatest obstacles to the elimination of accident hazards in industry. Mr. DeBlois is convinced that neither the nature of the industry nor the character of the materials handled, even though these be explosives, ammunition, or strong acids, such as are handled by the du Pont Company without any considerable difference in accident rates from those of so-called non-hazardous industries, has as much effect on the cause, frequency, and severity of accidents, as the safe design and equipment of plants, the provision of proper safety organization and the constant supervision and education of the working forces into habits of caution and careful practices. While well-paying positions are open in Government Arsenals and Navy Yards, the Emergency Fleet Corporation and large private industries, technically trained and experienced men who are capable of studying industry from all its angles and of making constructive recommendations for changes in design and operation which strike to the root of the accident evil, are woefully lacking, concludes *Safety*.

A pleasing background may be got—

The Industrious Photographer

All Pictures Are Not Pleasing; but with the Aid of Brush, Scissors, Paste and a Fresh Exposure, Several Mediocre Prints Can Be Combined to Make One Negative of Merit

By Percy Collins

no matter where a picture was taken

VERY striking results may be secured by piecing together the best features of two or more inferior pictures. All that is necessary is to have at one's disposal a fairly large and miscellaneous collection of negatives, such as every photographer of several years' standing is sure to have amassed. Of course some artistic skill and judgment must be forthcoming, but a very little practice will suffice to provide the necessary experience in this direction. Much of the work may be done during the long winter evenings, when the enthusiastic photographer usually has more time on his hands than he knows how to use.

An actual picture, recently prepared by the writer of this article, will serve to illustrate the methods employed. It represents some fishing-boats putting out to sea, the foreground being occupied by a solitary watcher who leans idly against a stranded row-boat. The germ of the idea was suggested by the pose of this man. Originally he formed one of a crowd gathered about a fish-salesman on the open beach. But his attitude seemed to be out of harmony with his surroundings—to merit a more artistic setting. Accordingly we hunted through our stock of seascapes, and eventually found one that seemed to meet the case. The negative in question was a bad failure, the sky being uniformly opaque, while there was nothing in the sea or foreground to arouse the least degree of interest. To this day we cannot recall why the exposure was made. However, it now came in useful as a basis for the combination that we had in view. Some pretty clouds were added to the sky; the man, boat and piled-up fish trunks were placed appropriately in the foreground; and lastly the three fishing boats—taken from a third negative—were utilized as finishing touches. The result is a charming picture.

How was all this managed? Very easily. First as to the sky, which, as we have seen, was really no sky at all—merely a blank white space when a print was taken from the first negative. This saved trouble, because no "blocking out" was required. When the sky of a negative is not sufficiently opaque, it must be carefully blocked out with one of the liquid preparations sold for the purpose; but in the particular case under discussion no such treatment was needed. We simply made a print in the ordinary way. Then we covered the sea and foreground with a mask of black paper—taking care to place this in exact register with the line of the horizon—and printed in the clouds from a second negative. Cloud negatives can be made by the photographer for his own use; but very beautiful ones can nowadays be purchased at very small expense.

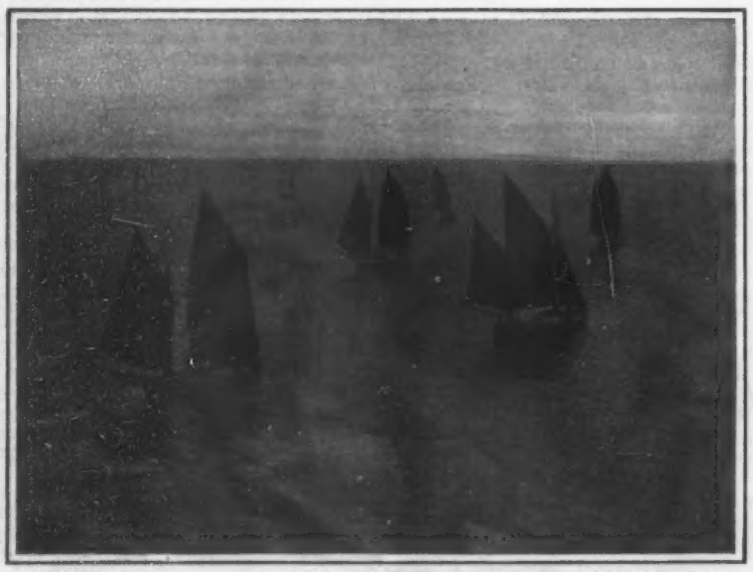
The little lady is out of place on the wash-pan, but picturesque enough when that homely article is transformed into a toadstool

The solitary figure leaning on the boat merits a more artistic setting

The actual combining of photographs may be effected in one of two ways. The first method consists in cutting up the prints and fitting them together after the manner of a jig-saw puzzle. Needless to say this calls for a good deal of skill and exactness in the matter of detail, and therefore occupies a vast amount of time. For this reason the plan of superimposing the several parts of the picture is recommended. It is far less laborious and with reasonable care gives excellent results.

In the first place the background print should be mounted upon a sheet of stout card. Then the parts of the prints that are to be combined should be carefully cut out with fine-pointed scissors. Afterward, it will be found advisable to go round the edge of each with a small brush dipped in waterproof Indian ink. If this precaution is omitted, the white edges of the cut paper will be apt to catch the light, thus rendering the outlines too strong in the finished picture. When all is ready, the cut-out parts must be fixed with good mounting paste upon the background, and squeezed flat. At this stage it may seem desirable to add a few touches with a brush charged with color—great care being taken to match the tints exactly. But this should be done very sparingly, since our object is not to paint a picture, but to produce one by legitimate photographic means.

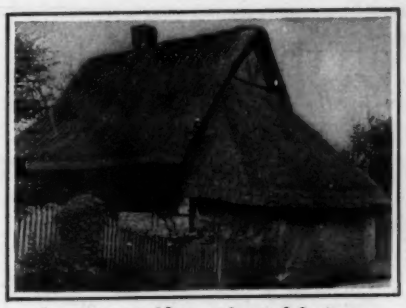
Eventually the combination must be rephotographed. The best way to do this is to support the camera with its lens directed vertically downward. All kinds of copying work is most easily managed in this way, the risk of halation being minimized. If possible, a slight reduction from the original will be an advantage, tending to sharpen the detail; but it is not essential. Indeed, if the exposure is correctly gaged, very satisfactory enlargements may be obtained. A successful negative should be difficult to distinguish from one made direct from nature.



Without an effective sky and foreground this picture lacks variety; but the industrious photographer can remedy that

By combining the two with a blank seascape, adding clouds and subtracting a few boats, a satisfactory effect is secured

Photograph combining is not always such straightforward work as the foregoing paragraphs may lead the reader to suppose. For example, a certain amount of rephotographing may be necessary before the actual assembling of a picture can be commenced. Thus, in the case of the pretty rural scene which figures in this article, we began with an uninteresting country road as background. We happened to have a team of horses proportionate to the foreground; but our only suitable thatched cottage was much too large. We therefore reduced it carefully to the requisite size, with the satisfactory result shown. This picture illustrates the advantage that is gained by substituting a mysterious corner — which may lead anywhere—for a long vista of dusty highway. Furthermore, the addition of the countryman and his wagon supplies the necessary vitality without which no scene is completely satisfactory to the well-balanced artistic temperament.



A cottage amid no animated features

Life shown with scant surroundings

One proficient in photograph combining will have no difficulty in finding outlets for the products of his skill. The demand for really attractive pictures of all kinds is well-nigh insatiable. Moreover, the pictures with a touch of novelty about them are those that find the most ready acceptance; and it is precisely these that the photograph combiner has it in his power to supply, since he is able to amalgamate the results of two or more exposures. Children and animals are admittedly difficult subjects, and when specially posed before the camera rarely made really pleasing pictures, their attitudes and expressions being strained and unnatural. On the other hand, a chance snap shot frequently registers a delightful pose—only the surroundings are too often unsightly or inappropriate. Such difficulties may easily be obviated by skillful treatment on the lines indicated above. Thus a child, originally portrayed in the homely environment of a back yard, may be transferred without difficulty to the center of a pretty country scene.

So far we have dealt only with pictures that may be composed from existing negatives. Still more striking effects may be produced when the negatives have been specially taken with the definite object of utilizing them for combination. An example of this kind—a child seated upon a toadstool—is herewith reproduced. Obviously this could not have been secured direct from nature; but it makes a pretty and quite plausible study—a decided improvement upon the stereotyped output of the average portrait-maker. Such unconventional methods are growing in popularity, and as they admit of endless variation, the reader should experience no difficulty in devising novelties for his exclusive use.

In conclusion the writer may point out the usefulness of photographic combinations from the standpoint of the contributor to the press. It frequently happens that a statistical comparison—such as the quantity of any commodity consumed by the average citizen in the course of one year — can be most strikingly shown by what is termed the "graphic method"; and in nearly all such cases dextrously handled photographs are far more convincing than drawings. Needless to say this kind of work calls for the ability to make very careful measurements and calculations, not to mention a knowledge of perspective; but these qualifications are worth acquiring by all those who aspire to a high-grade output. There is also a field for humorous composite pictures, of the kind now often seen in comic periodicals.

Motion Pictures and Patriotism

OF the various means of bringing the war and national issues before the American public, none has been more effective or more far-reaching than the motion-picture screen. For the screen has brought home to us the battlefields of Europe, in all their spectacular generalities and their gruesome details; the work of our courageous Allies on both land and sea; the activities of our leaders, and so on. In a word, the motion picture has lived up to its reputation of being the mirror of current events.

With a view to furthering the use of the motion-picture screen for patriotic purposes, the National Committee of Patriotic Societies, in coöperation with the Bureau of Commercial Economics and the National Board of Review of Motion Pictures, has recently published a bulletin under the title of "Patriotism That Registers." Invaluable information is given to the exhibitor and to all who desire to use motion pictures as a means of helping our forces win the war. A selected list of patriotic films is also included for the guidance of exhibitors and others. Copies of this bulletin, which has been written by A. Maris Boggs, M. A., Dean, Bureau of Commercial Economics, and J. C. Flinn, Advertising Manager of the Famous Players-Lasky Corporation, can be secured at 15 cents per copy or $12 per hundred from the National Committee of Patriotic Societies, Union Trust Building, Washington, D. C.

A somewhat bare and unsatisfactory photograph of a country road

But the combination of cottage, team and road makes a pleasing picture

American-built Auxiliary Schooners for French Government

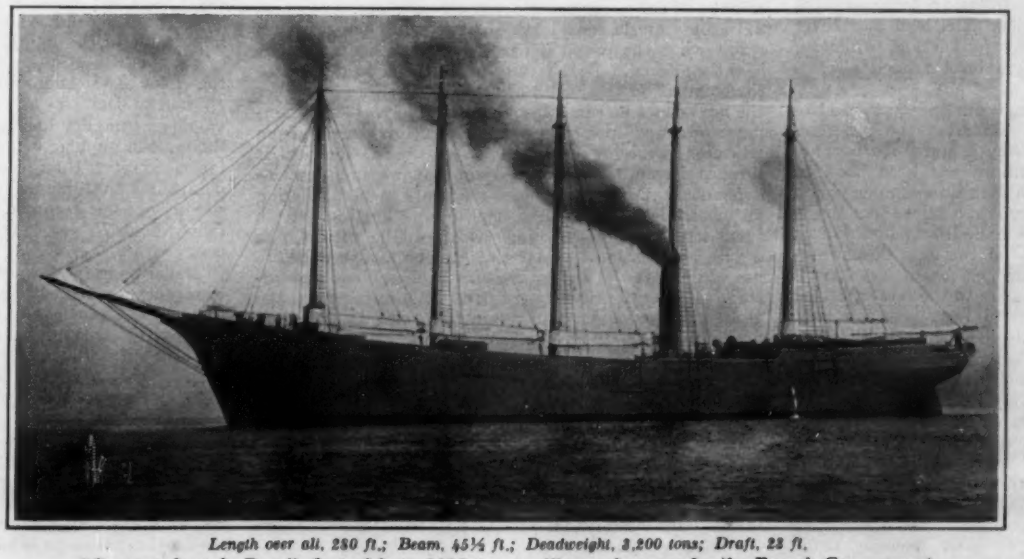
THE "Commandant de Rose," which completed her trials successfully on September 11th, and was accepted the following day by representatives of the French Government, is the 17th ship delivered by the Pacific Coast yards of The Foundation Company. These vessels are part of a contract for 40 3,000-ton deadweight auxiliary schooners awarded to The Foundation Company by the French High Commission in July, 1917. They are being built in two 10-way yards at Portland, Ore., and Tacoma, Wash.

As shown in the accompanying photograph, the schooners are of the five-masted, baldheaded type. The auxiliary power consists of twin 350-horse-power triple-expansion steam engines, supplied by coal-fired, water-tube boilers. They give a speed without the assistance of sails of about 8 knots loaded.

The general dimensions of the hulls are: Length over-all, 280 feet; beam extreme, 45 feet, 5 inches; approximate deadweight at 23-foot draft, 3,200 tons.

The ships were designed by Messrs. Cox & Stevens of New York City, and are being built under direction of the Bureau Veritas, which classifies them A-1 for 15 years.

The construction and complete equipment of the schooners is being carried out by The Foundation Company under the management of Bayly Hipkins, Vice-President, who is in charge of the company's Pacific Coast shipyards.



Length over all, 280 ft.; Beam, 45½ ft.; Deadweight, 3,200 tons; Draft, 23 ft.

"Commandant de Rose", first of forty 3000-ton auxiliary schooners for the French Government

New and Interesting Uses for Zinc

BECAUSE of the large supply of zinc in the United States, now the largest producer of this metal in the world, and because former uses of zinc have had to be discontinued on a large scale because of the war, new ways to consume the metal have had to be devised. The testimony of an American authority on this subject is of decided interest now.

In the first place, the present shortage of steel has necessitated manufacturers turning to other metals in order that they may be able to produce their manufactured articles during these war times; and this emergency should be turned to our permanent advantage and profit. The refrigerator manufacturers are turning to zinc sheets, and it is well known that zinc makes not only a much more sanitary lining for a refrigerator than galvanized iron, but a more durable one, and so in the long run a less expensive one. Some of the States are considering the use of zinc for automobile license plates. This is a field which could be materially extended, at least so long as the scarcity of steel continues.

Zinc for numerous small articles, such as shoe and corset eyelets, lace tips, show clips and metal buttons, is in every way as satisfactory as brass and materially less expensive. The enameling of zinc seems to offer no insurmountable difficulty; there is good reason to believe that it can be as beautifully and durably finished as other metals. Cornices, ceilings and other fancy sheet work heretofore made of copper and steel could as readily be made of zinc with the same advantage as to cost as in the case of roofing.

Trench mirrors of polished zinc are war-time articles. If zinc can be polished in time of war why not polish it in time of peace, and turn the article so made to some advantage? Reflectors for automobile lamps, searchlights, etc., are suggestions along this line.

Telephone and telegraph wires made by twisting two strands together helically—one of iron or steel to give tensile strength and one of zinc to give conductivity—may be used to supplant copper wire.

Zinc of certain physical characteristics can be spun for ornamentation and fixture work. In this age of the automobile and tractor, this field could be made to require a big tonnage of zinc.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Electrochemistry in War

So much has been said about the fixation of atmospheric nitrogen as a source of nitric acid for munition manufacture and nitrates for fertilizers that there seems a possibility of forgetting other electrochemical and electro-metallurgical processes and their relation to successful warfare as well as prosperous peace. Because of its fundamental importance in war nitric acid and nitrates from which it may be made have naturally held the center of the electrochemical stage, for a shortage of nitric acid means a shortage of explosives. Years before the war Germany realized the importance of synthetic nitrates and, while piling up Chilean nitrate reserves, continued research. In 1912 the synthesis of ammonia by the combination of atmospheric nitrogen and hydrogen was announced, other processes were perfected and controlling shares obtained in the plants of neighboring countries. Yet when Italy joined the Allies and the route of imported nitrates was closed, Germany called in her chemists and ordered more synthetic nitrates as well as an increase in efficiency in established plants.

With our government investing more than one hundred million dollars in electrochemical plants the importance of hydroelectric power is emphasized, while in France the development of water powers to generate electricity as a substitute power for steam (not now to be had due to a lack of coal) has been extended so that many thousands of tons of fuel will be conserved annually hereafter.

We recall having seen a cartoon during one of those periods of argument as to whether Niagara Falls should be made more useful, showing a silver dollar carved on the rock ledge of a dry Niagara and entitled "The Maid of the Missed." We also remember a remark to the effect that for thousands of years, Niagara has done nothing but wear down rocks while now it can be both beautiful and useful. Those to whom the cartoon appealed may be cheered to know that all the water drawn from Niagara River for power is said to have lowered it but a few inches, while to the others it is encouraging to know that war has at least emphasized the importance of electro reactions and led to the development of other centers of water power. Then our steam engineers have already shown that in favorable localities electric horsepower may be generated from steam at a price to compete with the hydroelectric variety.

It is not our purpose to discuss here the economies of power production nor the value of Niagara's beauty at full tide. Let us consider some of the uses of electric power aside from domestic or street lighting, motors for general industry and for transportation. Utilizing electric energy, chemistry is able to bring about changes in accordance with natural law and to accomplish in a few hours results which would have required geological periods of time in Nature's own laboratory.

Electricity was first used by the chemist for electroplating, in which process one metal is coated with another for purposes of preservation, wear, decoration or deception. A natural outgrowth was the electrolytic refining of metal, which is of great importance since by no other method may copper of sufficient purity for the more exacting electrical work be made. Bessemerized copper matte may contain besides copper any or all of the following: copper sulphide, copper oxide, gold, silver, platinum, iron, nickel, cobalt, arsenic, arsenic trioxide, antimony oxide, bismuth, bismuth oxide, selenium, and tellurium. This impure matte is partially refined in the furnace from which the copper is cast into anodes, and the remaining impurities are either precipitated as insoluble matter or they dissolve without plating or are so changed as to be unaffected by the process, so that copper more than 99.9 per cent pure results. Seven-eighths of the 2,350,000 pounds produced in 1917 was refined electrolytically.

Under the necessity of war electrolytic refining methods have been developed for complex zinc, lead and silver ores, thereby greatly increasing production, while for some time gold and silver have been refined electrolytically at the mints.

About twenty-five years ago our present electrochemical development began. Some of the processes are electrothermic, others electrolytic and still others are combinations of these. Aluminum has been changed from a museum curiosity worth many dollars per pound to an important metal of commerce at a price encouraging its industrial application. It is made from bauxite fused in a cryolite bath, and because of the high power consumption, 25,000 kilowatt-hours per ton of metal, it is economical to transport the bauxite to the power, rather than to attempt the reverse procedure.

Magnesium is also an electrolytic product, being made from magnesium chloride. It has an appearance similar to that of aluminum but is much lighter in weight. It forms, with aluminum, the alloy magnalium which is light and strong while with traces of copper and manganese unusual strength is gained with minimum weight. Such alloys are of great value in many engineering designs while magnesium metal provides material for star shells, flares, rockets, flash powders and other devices for intense illumination.

Abrasives are essential for properly finishing many metal parts. The natural abrasives, with a few minor exceptions, are of foreign origin so had not our artificial abrasive plants been equal to the emergency we would be seriously handicapped in war work. Silicon carbide, made by fusing sand and carbon, and fused alumina supply 100 per cent of the abrasives used in grinding and polishing operations in others than the glass industry. They are harder and more uniform in grain and abrasive quality than natural abrasives. Moreover, being made under controllable conditions the product is quite dependable.

Artificial graphite, which is of equal importance with copper in the electrical field, was discovered by accident due to the overheating of a carbide furnace. It is now made from heating carbide with a metallic oxide, and the production has grown from 800,000 pounds in 1900 to forty million in 1916. Artificial graphite serves as electrodes in electric furnaces, etc., and nowhere in nature can sufficiently large blocks of carbon uniform in structure be found for this service. Furnace electrodes may be 17 inches or more in diameter and to obviate the necessity for stopping the work to renew the carbons, they are molded with threads and provided with nipples which permit joining lengths and this results, in service, in savings in time, electric energy and materials. Artificial graphite also enters into lubrication efficiency, pencils and several items of less importance.

Calcium carbide, familiar to many as a source of acetylene for bicycle lamp illumination in the old days, has come to have great importance besides its use along the well known lines of lighting and welding. It is made from calcium oxide and carbon in an electric furnace. Under proper manipulation it fixes more nitrogen than the arc processes used abroad, yielding cyanamid. From cyanamid nitrates for war and peace may be made. Furthermore from calcium carbide we may obtain acetylene which is now being successfully transformed into acetone for explosive manufacture or to acetic anhydride by a series of complex processes involving catalysis. Acetic anhydride is one of the raw materials required for cellulose acetate production and from this substance we get windshields for aviators, non-inflammable goggles, windows and quantities of a solution called "dope" to be applied to the wings of our birdmen, imparting permenent tauntness to the fabric regardless of the presence of moisture or oil. Besides it is spark and flame proof. In times of peace cellulose acetate is made into a valuable and unique artificial silk. Acetic anhydride production formerly depended upon the gray acetate derived from the destructive distillation of hard wood and it is very doubtful whether the sudden and greatly increased war demand could have been met from that source alone.

See where the invention of "Carbide Willson" at Spray, N. C., has led us in less than a generation! Indirectly his product has been made to provide us with sinews of war, fertilizers for our farms, a fiber for cloth and other important materials.

Phosphorus was formerly made in earthen retorts, the process consuming sulphuric acid and much time. It is now made in an electric furnace from phosphate rock or bones, which are fused with carbon and silicon dioxide. Time is saved and the new method is more satisfactory in several respects.

Caustic soda and chlorine are of fundamental importance. The relation of caustic to war conditions may be illustrated by its increased production which is now 68 per cent more than the pre-war output. Both chemicals have wide industrial applications in peace and war and result from the electrolytic dissociation of common salt. The salt is fused or it is electrolyzed in the form of brine. Complicated reactions are involved and engineering problems of the first order have been solved in increasing efficiency in yields, prolonging the life of the cell, raising the purity of product, improving the method of collecting caustic and chlorine, etc.

In alloy steels considerable changes in characteristics result when the proportions of the constituents are but slightly altered. Best results would seem to depend to some extent on the purity of the steel itself and whether the heat could be carried on quantitatively. This exacting work was formerly done in crucibles made from mixtures involving imported clays. Then the electric furnace began to be applied so that we are now independent. Many types of furnace are in use, differing in mechanical details and method of heating. With them steel and ferrous alloys can be made with a high degree of precision for materials can be analysed before use while time and energy consumption can be standardized. From 19 furnaces in 1913 the number in the United States has risen to 233 in 1917 with an estimated production of 750,000 tons.

As research has gone forward a whole ferro family has been introduced to engineers and the consumers of steel products. These include ferro-chrome, -manganese, -molybdenum, -nickel, -silicon, -titanium, -tungsten, -uranium, -vanadium. These alloys are of vast importance. They lend toughness, hardness, strength, elasticity and other desirable qualities to steel, making possible the automobile, airplane, battleship, and the host of vital machine-made products upon which we have become dependent.

Ferro-chrome is necessary in armor plate production and is also used in making armor-piercing projectiles. Ferro-silicon is an essential in basic open-hearth steel production, which made up the greatest part of our forty million tons of steel in 1917. Without it we could make no sound steel castings, no shrapnel. Without ferro-tungsten and the other tool-steel alloys our munition production would be in a sad plight, for it is such steel that enables a lathe which has been using high carbon steel to nearly triple its output by employing tungsten steel tools, since ferro-tungsten permits a larger cut to be made or a much increased speed to be maintained. In other words it withstands a much higher temperature without losing its cutting edge.

Electrochemistry extends beyond inorganic lines and touches the great organic field. It offers an ideal method for many oxidation and reduction processes, for its use introduces no foreign substances such as are inevitable when chemical reagents are employed. Iodoform is made from potassium iodide and acetone or alcohol, and chloroform may be produced using acetone and chlorine by electrolytic methods. Carbon tetrachloride is another example.

Dyes of several varieties depend upon electrochemical products if not on electrochemical methods. Sodium caustic is an important reagent in the indsutry as is chlorine and chlorine products, for example chlorbenzene.

By the electrolytic dissociation of water hydrogen and oxygen are formed, both being gases of fundamental importance. Burned together under proper conditions they form the oxy-hydrogen blow-pipe. Oxygen with acetylene gives an even higher temperature and provides our most efficient method for welding and cutting metals. A small amount of oxygen is used medicinally. Hydrogen at present holds a place of great economic importance for the hydrogenation of oils. This process makes it possible to build up the more complex fat bodies resembling hard fats from lower grade and less expensive oils. Even though little more than in its infancy, much has been accomplished in the industry not only in supplementing our supply of edible fats but also in so improving such oils as fish oil that edible oils may be replaced in industry by them. This accomplishes fat conservation besides being an economic gain.

Only an indication of what electricity does in chemistry can be given here. The future undoubtedly holds much in store, not only in new methods or products but in new applications of present knowledge. It has been suggested, for example, that some day we will remove water from mines by gasifying it electrolytically instead of by pumping. At all events to fail to use fully our water powers means a waste of resources which cannot be replaced and places an obstacle in the path of progress.

The Relative Sweetness of Sugars

In the Scientific American for August 17th, 1918, there appeared a note on this page entitled "Fourteen Pounds of Sugar Out of Ten," which has at least called forth a variety of opinions with the result that considerable effort has been made to check up Professor Willaman's figures. The whole difficulty lies in comparing the sweetness of various sugars and when it comes to making the comparison quantitative the question is complicated. Besides there are different kinds of sweetness and some are more persistent than others.

The literature is not clear on the subject for while Armstrong in Allen's Commercial Organic Analysis says, "Invert sugar is an uncrystallizable syrup, having a sweeter taste than cane sugar," and Blucher in Modern Industrial Chemistry says, referring to invert sugar, "It is sweeter than cane sugar," J. H. Hillebrand, Principles of Chemistry, says, "Since the resulting invert sugar does not easily crystallize, and is moreover, less sweet than the equivalent amount of cane sugar it is important, in the refining of sugar, to avoid all acidity of the sugar solutions. When stewed fruit is sweetened the effect of the sugar will be greater if the fruit is first allowed to cool."

Diligent inquiry has failed to reveal any actual figures though the popular belief seems to be that invert sugar tastes sweeter than cane sugar. Professor Willaman points out that honey is universally recognized as the sweetest of our common sugar products and yet it contains about 75 per cent invert sugar and but two per cent sucrose.

The error in the former article seems therefore to have been one of arithmetic and not of principle. After all the test of the sugar is in the eating and a number of housewives as well as at least one ice cream manufacturer have followed the suggestion with entire success. Further, careful trials made by diluting solutions of invert sugar and cane sugar, made from the same weights, until the sweetness was just perceptible indicated that, to many tastes at least, invert sugar seems much sweeter. Have you tried it?

An unfortunate error in printing the formulae of sugars was made and should be corrected. According to authority and omitting water of crystallization sucrose or cane sugar is $C_{12}H_{22}O_{11}$ and glucose and fructose are $C_6H_{12}O_6$.

Some Aviation Economics

What Are We to Do with the Vast Industries After the Sword Is Sheathed?

By C. H. Claudy

THE most optimistic prophet concedes at least another year of war, and many very learned and skilled military men give it a much longer duration.

There have been delays in the aircraft program; we have merely hundreds of planes at the front when too hopeful an attitude from many in authority told us we would by this time have thousands. In spite of this, the fact remains that the United States, the most backward of all civilized countries in developing its aircraft industry, is now forging to the front in such a rush that before very long—certainly before the war ends—it will lead the world in the production of aircraft and of motors, and will possess more factories, more workmen, more capital invested and more flying fields than any other two, and possibly three, countries considered as one.

If this is so—and no one at all familiar with what has been done and is now being done in furthering aviation by this country can doubt it—then the status of American aviation after the war presents a problem of such acute interest, such economic importance, and such scientific need as is possessed by few, if any, of those post-war riddles which the world is trying to solve in advance of their presentation.

Possessing a fully developed industry, an army of skilled workmen, hundreds of millions if not several billions of dollars invested in factories for the production of planes and engines, it is obvious that we cannot stop production, scrap the plants and throw the workmen out of jobs, all in a moment, without a very serious effect upon labor and capital. Moreover, to cease as suddenly as we began would be to lose to this nation a series of benefits from this war activity, which may well turn out to be, next to the blessing of peace itself, the greatest reward we will have for our participation in the conflict.

Far-seeing men who have given much thought to the subject see in the development of aeronautics by the war the most tremendous factor for world progress since the invention of the steam engine. Since the steam engine all our transportation progress has been a matter of direct evolution. Electric trains, the automobile, steamboats, railroads of all kinds including high-speed electric lines, possible monorails and gyroscopic trains of unheard-of speeds, are nevertheless all developments of transportation on the surface of the earth and water. Even the submarine, as a transportation medium, can well be regarded as a surface activity, since for peace-time cargo carriage it gains little from its invisibility.

But now comes the aircraft, defying every influence which turns traffic from the straight line, and at once shortens distance and abbreviates time. It makes nothing of mountains, forest, bogs or swamps. To that craft which soars above them, deserts, ice fields, any unfavorable conditions of terrain are nothing, so long as it soars and has not to land.

What this will mean we as yet only glimpse. Our mail service via plane, established with scarcely a ripple of publicity, is but a straw showing the direction of the wind, as was the first railroad train a straw. No one realized then that the inefficient little puffing steam engine with its road-wagons on rails was progenitor to that network of steel which alone made possible the development of this nation as a nation; so, few realize today that the as yet somewhat tentative aircraft which fly back and forth between the capital and the metropolis, are the first beginnings of an aerial transportation service which will have a broader and deeper effect on this and other nations, than any transportation factor yet devised by man.

It would seem then, that it is by no means too early to seek to plan for the future of our aircraft industry, no matter how far away peace may actually be. Reference is not made here to the small governmental beginnings already made. We have a Committee on Civil Aerial Transport, formed of men whose qualifications enable them to attack the problem with intelligence and understanding. But no single committee, be it never so able and be its resources what they may, can do for this subject what must be done if the United States is to remain in the forefront of aviation and reap the benefits of its enormous war aviation program.

The best thought of the country as a whole is needed, and plans and suggestions must be forthcoming from a much larger number of brains than can be mustered into any committee. The problems are so numerous, and the possibilities so vast, that it is hardly possible we can either solve, or as much as begin to realize, them all in time, even if the war is indefinitely prolonged. But if we only make a start, we shall have done much.

Among the first problems presented in a study of the subject is the possibility of governmental use of airplanes, outside the military service. No one doubts that, end the war when it may, we shall be many years in reducing our military establishment to anything approaching our former state of unpreparedness. The planes in existence will find one outlet in continued military work, and to some extent the existing investment and the trained workmen will continue to supply our own army and navy. But we will not then be in a position to supply foreign nations (as, for instance, we are now, supplying Liberty Motors as fast as we can turn them out), because France and England and Italy are all confronting the same problem—what to do with their aircraft industry after the war. A foreign outlet for our product after the war is a practical impossibility from either a government or a private purchaser standpoint.

Of governmental uses of aircraft outside the military establishment, the mail at once suggests itself as the most promising. There is small doubt that the Washington-New York mail route is but the first of hundreds. But for the immediate future at least—and by immediate one thinks in terms of years of one figure—inter-city mail service, if it is to pay its way, is to be confined to routes between large centers. Purely and simply as a business proposition, the day when Squeedunk and Rubeville are connected by mail plane routes is not to come soon.

As there are but a limited number of large cities—roughly, fifty with a population of more than 100,000—it is obvious that even if each were connected with its nearest neighbors by plane, and if it required six planes to start a service, and if all these required replacement every year, the total number to be used would be between three and five thousand per year. If our annual output of planes is somewhere from twenty to a hundred thousand by the end of the war, the utilization of output in mail service would be but a small percentage of the total.

That the government can use airplanes in its Coast Guard establishment is unquestionable. Already the experiment is being tried. As many readers know, the United States has the most extensively organized life saving establishment in the world. But even if every one of its stations were equipped with two planes (a condition which would be foolish to establish, since the distances separating these stations is small), the total output of planes required per year to replaces losses would be insignificant.

There are several interior services which can, and probably will, use planes with great effect. In Reclamation, the plane offers a new and novel method of exploration for water conservation possibilities. The development of aerial photography, which has been a hot-house

(Continued on page 323)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Steam Cars in the Philippines

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of December 1st, 1917, of THE SCIENTIFIC AMERICAN, I saw an advertisement of a new steam automobile, and in the issue of December 15th, I read an article on this same car, "New Steam Motor Truck." It roused my interest and I saw great possibilities of steam propelled vehicles in the Philippine Islands. I wrote the advertisers, asking for a booklet or catalog of their steam cars. Up to this time I have not heard anything from them. I am sure that many American automobile and machinery manufacturers are ignorant of the future automobile possibilities of the Philippines. The Philippine Islands is an agricultural country, exporting only raw products, so it is a good market for machinery and even more for automobiles. At present, according to Government statistics, there are in this country about 8,000 cars (automobiles and trucks), valued at $7,500,000. Taking the automobile development so far, this is pretty high buying for such a country of hardly 9,000,000 inhabitants.

Ninety-nine per cent of the cars here are gasoline cars. At present there is a lull in the automobile market and I am sure the situation will go on for some years to come. Nobody will buy any more gasoline cars on account of the exorbitant price of gasoline, and everybody wants to get rid of their cars. I remember very well that five years ago I bought a case (two cans of 5 gallons each), of gasoline for $2.50, now it is $25 a case and a very poor grade at that. The fact is that the actual gasoline on the market can not drive those cars of six years ago. Of course anybody that is acquainted with the present circumstances can not blame the producers, because the increased demand and the limited supply have forced the producers to market a grade of gasoline that is inferior to any that has ever been sold under the name of gasoline. I am also aware that gasoline is one of the vital factors in this war and if press reports are true, the situation is growing worse. War needs must be uppermost, but I am sure the situation will go on even after the war. The only solution, as I see it, is in the steam cars, which eliminate the use of gasoline altogether. Kerosene here is at $5 a case of 10 gallons which is not cheap but very much cheaper than gasoline.

We must have cars, not only pleasure cars but commerical trucks as well, but in the present circumstances we can not afford it. The development and manufacture of steam cars must be encouraged and its manufacturers must take more interest in the Philippine market. I will even take the risk of saying that in three or four years more steam propelled cars will predominate here if introduced now.

I wish that you publish this letter in your correspondence column of THE SCIENTIFIC AMERICAN for the benefit of all concerned. JUAN CARBALLO, JR.

Manapla, Neg. Occ., Philippines.

August 23d, 1918.

What Shall We Burn In Our Cars?

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of September 7th, in the article "New Engine Fuels," you say: "The kerosene carburetor is yet a myth, so far as the automobile is concerned."

A veterinary at New Holland, in this state, has a kerosene carburetor on his small car, and has used it for several months. He says that it gives the same satisfaction as gasoline, and that its mileage per gallon is greater. Of course, it is cheaper. It requires gasoline for starting, a small tank being provided in this connection.

The claim is sometimes made that the kerosene will eventually dissolve the lubricating oil in the cylinders, causing these to cut worse than with gasoline; but my friend says he has yet seen no evidence of this in his car. The makers of his carburetor claim to have 50,000 in use. It does not seem likely that they could sell 50,000 "myths."

It seems that such a characterization should not be applied so broadly. We are faced with a critical situation in motor fuels; and anything which promises so well to help out as does a successful kerosene carburetor should receive encouragement rather than discouragement. If these carburetors are a success, and if there is ample supply of kerosene, the way is open to save an enormous amount of the higher grade fuel for use overseas. But opinion is not unanimous as to the extent of the kerosene supply. The Fuel Administration goes so far as to state that oils of any kind are scarce, and that conservation of kerosene is as important as of gasoline.

If this is the case, there might be some relief by the use of alcohol. In your article, already named, there was a reference to the use of alcohol in Africa, in which this alcohol was stated to have been tested in London and found superior to gasoline. I understand that one of Detroit's leading automobile makers has a distillery for experimentation in making alcohol for fuel purposes. A cheap successful alcohol product for use in engines would apparently relieve the shortage entirely, and help largely in winning the war; for we shall have to be in far more desperate straits than now before it can be stated that raw materials for alcohol manufacture are scarce, and must be conserved equally with everything else.

That the situation has more angles than usually realized may be inferred from the following quotation from a recent review.

"England has prohibited, with drastic penalty, the use of gasoline for pleasure vehicles. The United States would have followed the same policy, were it not that this country, unlike England, is a producer and refiner. The greatest demand is for fuel oil, and in the manufacture of this the explosive gasoline must be removed. This gasoline at the present time is in this country largely a by-product. The greater the demand for fuel oil, the greater the supply of gasoline."

It is not stated just what is meant by "fuel oil," but probably it is kerosene and similar products. In any event, it is clear that in war times things move so fast that it is hard to keep up with them.

May I comment also on your editorial of September 21st, "Motorless Sundays"? It is reported that the Fuel Administration considered the issue of cards, as you suggest, but concluded the expense of keeping track of the same would be too great.

This is undoubtedly correct. It is true that every car has a license number; but a car can cover a good many miles in a day, and unless a record of every car supplied with gasoline were checked up at some central office, it would be impossible to determine whether some car were exceeding its allowance. This would require a vast number of clerks.

Now Sunday driving is mostly for pleasure; and while the working man should not be denied any legitimate and reasonable relaxation, one paper points out that with 40,000 casualties already and the ever-increasing list coming in from the battle front daily, we should not display too great frivolity. People got along, and had good times, before the automobile was invented. Perhaps our descendants will say that they just can't see how they are going to get along of a Sunday without their airplanes. But we do very nicely without them; why not without our cars too?

The war will be over some day. Until then, in the absence of a good substitute for gasoline which can be manufactured without prejudice to our military affairs, why not agree that in addition to its cost in gasoline, a Sunday automobile ride costs good money also—money that ought to be used in buying bonds and stamps? The man who goes to France to fight doesn't get much action out of the money he has invested in his car; is it too unreasonable to ask the same amount of temporary deprivation of the man whose other sacrifices are less than those of the citizen in khaki? E. R. C.

Greenfield, Ohio.

Salvaging the Steamship "St. Paul"

How a 13,000-ton Ship, Lying on Her Side Many Feet Under Water, Was Rolled Over and Floated

THIS is a story which concerns a famous ship and two widely known firms, that are familiar to the readers of the SCIENTIFIC AMERICAN, viz., the American-built mail steamship St. "Paul," which for over twenty years has had a useful and, at times, adventurous career, both in peace and war; the International Mercantile Marine Company, her owners; and the Merritt & Chapman Derrick and Wrecking Co., who have just completed the work of lifting this fine ship out of the 32 feet of mud and 54 feet of water, which had engulfed her as the result of an untimely accident.

The "St. Paul" and her sister vessel, the "Philadelphia," will always form a conspicuous landmark in the history of the American merchant marine. They were built at the Cramps yard in conformity with an Act of Congress, which permitted the purchase of the English vessels, "City of New York" and "City of Paris," on condition that two American mail boats of equal size and speed be built in American yards.

The "St. Paul" went into service in 1895; and it speaks well for her construction, that, in spite of 23 years of practically continuous and very hard service, including a spell as an armed cruiser during the Spanish War, she should be today a perfectly sound ship and capable of many long years of service in the days to come.

On April 25th of this year the "St. Paul" left the Erie Basin, where she had been in dry dock, and was being towed into position between Piers 60 and 61, North River, when, with little warning, she heeled heavily to port and sunk in 54 feet of water.

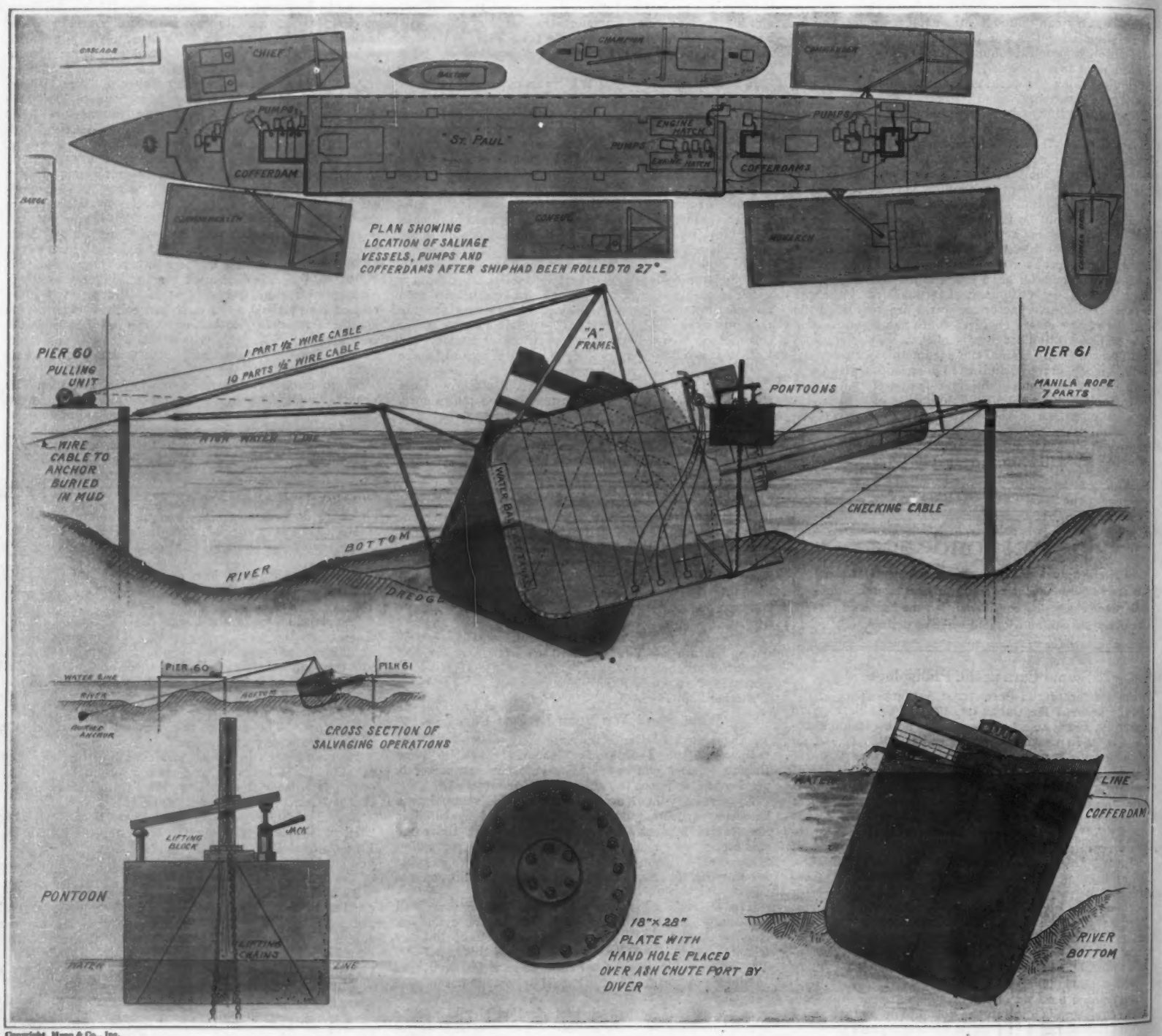
The work of salvaging the vessel was given to the Merritt & Chapman Derrick and Wrecking Co., who found the ship lying on her port side with a list of 73 degrees. They realized that the problem of righting the ship and floating her was one of great magnitude. Mr. Ralph E. Chapman, representing the salvors, informs us that the total weight of the ship was calculated by the engineers of the American Line to be about 13,000 tons at the time of the accident and the salvors estimate that when the "St. Paul" settled in the mud some 2,000 tons of mud entered the lower part of the ship or lay in the alleyways on the port side on decks No. 1 and No. 2.

It was determined to carry out the salvaging of the ship in three stages:

First, the sealing up of certain holds forward and aft, and the rolling of the ship over by means of cables and heavy tackle attached to A-frames and operated by steam winches on Pier No. 60, until she rested on her bottom, near enough to upright to permit building a cofferdam.

Second, the closing of all openings below water, the construction of a cofferdam, and the pumping out of the ship—the righting effect of this pumping being assisted by pulling on the A-frames above referred to. This reduced the list of the ship from 27 to 17 degrees.

Third, the pumping out of the entire ship and floating her to her normal draft.



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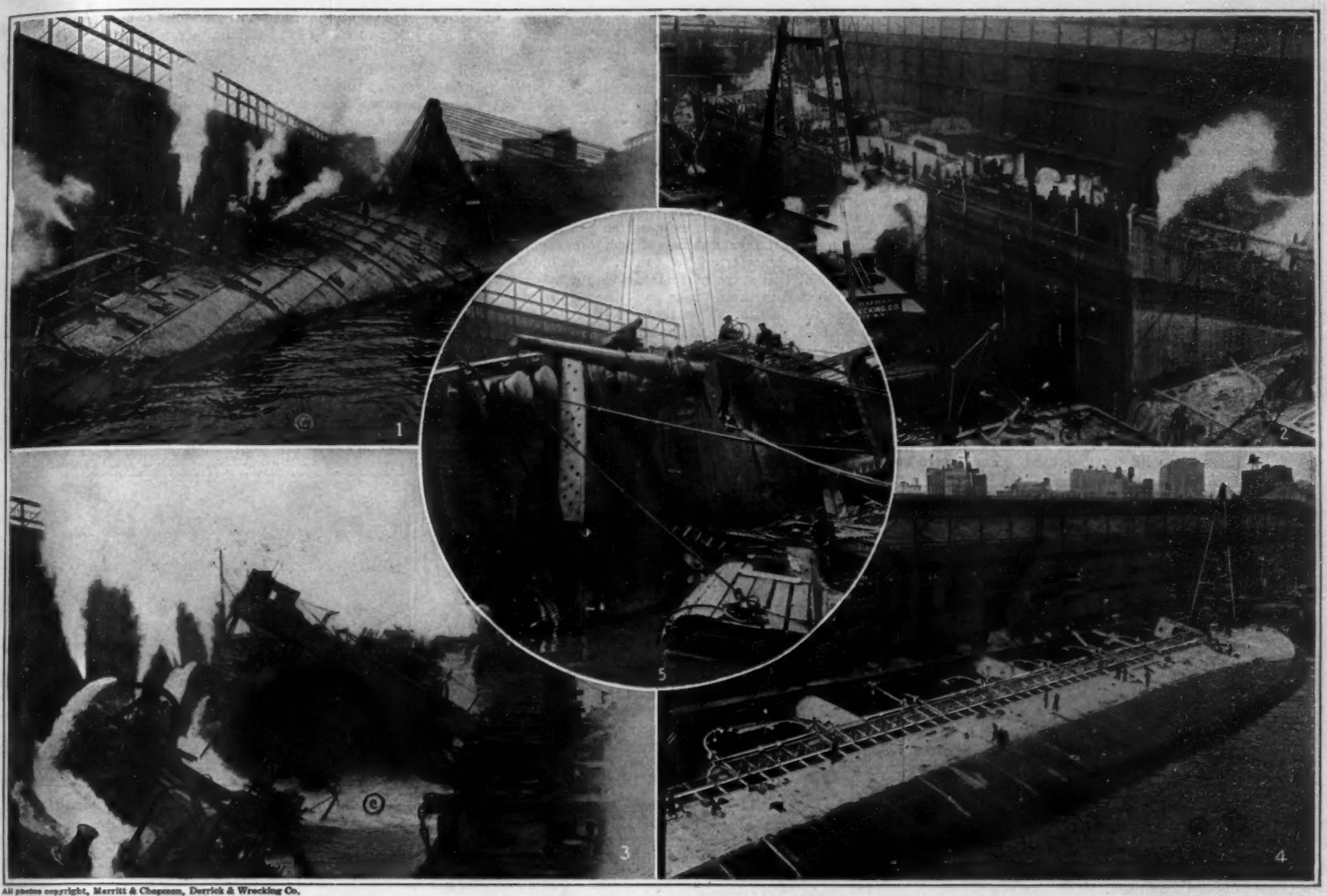
These sketches show the wrecking plant and methods used in raising the "St. Paul"

The First Stage

In order to reduce the overturning moment of the ship, and also to provide working space between the "St. Paul" and Pier 61, the two smokestacks and the two masts were cut away at the level of the top deck by the use of dynamite; also, all top weight was removed, including two 6-inch guns forward, and a 4-inch gun aft. This lightening of the ship included the removal of all boats, davits, gun ammunition, the fittings of the upper deck houses, and all beds, bedding and various other detachable ship material. This clearing of the ship was carried out on the sun deck, the first and second decks, and partially on the third deck. The next step was to prepare and place the gear for rolling the ship over. For this purpose 21 massive A-frames were erected on the starboard side of the "St. Paul." Each frame consisted of two braced, angle-iron, vertical posts 30 feet in height, and two 10-inch by 10-inch diagonal posts, as back legs. The footings of both the verticals and the back legs were so placed as to come at the point of conjunction of decks No. 2 and No. 6 with the side plating of the ship, thus avoiding any tendency to distortion of the ship's structure. Heavy tie rods with turnbuckles led down from the head of the A-frames to the edge of deck No. 1. To obtain suitable anchorages to take the strain on the pulling cables, a trench was dredged down to 68 feet below low water between Piers 59 and 60, and in this trench were placed twenty-one 10-ton, concrete anchors with wire pennants attached. The anchors were then consolidated by filling the trench with earth. The pulling was done by 21 hoisting engines, on Pier 60, which were capable of exercising a pull of 40 tons on each cable or a total pull of 840 tons. In order to prevent the ship from sliding over towards Pier 60 under the pull of these cables, checking cables were attached to the starboard side of the ship at deck No. 1, led beneath the bottom of the ship and made fast to Pier 61.

The rolling effort at the head of the A-frames was assisted by four large pontoons disposed along the port side of the ship, as shown in our drawings. Heavy chain cables were made fast to the port side of the "St. Paul" and led up through wells in the pontoons and there made fast to hydraulic lifting gear of the character shown in one of our drawings. This consisted of heavy beams, one end resting on a rocker and the other end



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1. The first stage of the pumping and rolling operations. 2. The great cofferdam on the lower side of the vessel. 3. Looking aft, pump discharge to left, pontoons at right
4. The "St. Paul" as she lay on the bottom. 5. A six-inch gun on starboard side of the fore deck

Views of the salvaging operations of the "St. Paul"

resting on the head of an hydraulic jack. After each stroke, the chain was looped over a hook carried in a frame above the hydraulic gear. Since the total pull on the A-frames was 840 tons, and the total lifting effect of the pontoons and their hydraulic gear was 1,200 tons, it follows that the total righting effect was over 2,000 tons.

It should be mentioned here that, as the vessel was slowly settling in the mud, divers went down as soon as possible and started closing the port holes from the inside so as to prevent more mud from entering the ship, which had sunk so far that the mud between Pier 61 and the wreck was from twelve to fourteen feet upon the deck; also extensive dredging had to be done to make it possible for the divers to get down to the port side and

(Continued on page 325)

A Successful Cotton Picker

By Edward C. Crossman

DOWN in the Imperial Valley, California, where the mercury pirouettes gracefully between the 100 and 120 mark during the summer, and where the only drawback to raising cotton is the inability to get the garnerers thereof in the hot months, there is working a cotton picking machine which, with the hard cash of the harvester "trust" considerably invested in it, must rank at least beyond the wild-eyed, blue print stage.

To date the machine has produced cotton cleaner than that hand picked, and to date it has beaten three and four to one the pickers working by hand process as contrasted with the inexperienced men handling the picking nozzles. All of this was with the mercury around the 115-in-the-shade mark, when both pickers and crew of machine were more concerned in keeping from catching fire than in making cotton picking records.

The largest and most experienced cotton broker in California has pronounced it practical and a success, and was the means of getting the harvester aggregation to turn its cold and fishy optics in the direction of the machine, and to untie the many knots in its purse-strings to build the present and second model.

The machine weighs but 1,000 pounds, and so is easily moved around from place to place. Draped artistically around its light skeleton are the 300-pound, 16-horse-power engine, the suction pump for the nozzles, and the centrifugal separator for parting the cotton from the leaves, sticks and what-not, taken in by the open minded picking nozzles.

An 8-foot pipe runs transversely over the machine, and from this extend the light, 18-foot rubber picking pipes with their patent nozzles, five of them in all.

The powerful suction pump on the machine endeavors constantly to keep the picking pipes in a state of vacuum, wherefore, when the nozzle is passed over a row of bolls, the suction picks up the cotton and carries it through the pipe and to the centrifugal separator. Here a powerful fan with hollow vanes, a departure in fan construction, separates the cotton from the leaves, the sticks and the "motes," which are not desirable, and finally drives the separated mass through a curved pipe at the rear. The leaves and motes are driven out through perforations in the top of the pipe, the cotton is driven through to the sack or basket at the end.

(Continued on page 326)

A collection of views of a novel cotton picker which works along lines strongly suggestive of the vacuum cleaner

The Federal Government's Mussel Farm

THERE is one increase in price for which the war cannot be blamed. The high water in the Mississippi valley, by greatly decreasing the season's supply of mussels, is responsible for the fact that the value of pearl buttons, now an almost indispensable article, has gone up from two to three hundred per cent, according to the quality of the button. And this advance is not the trivial matter it might seem.

Few of us are familiar with the magnitude of the pearl button industry, which has made several millionaires, gives employment to thousands, and, best of all, supplies the clothing manufacturer with good pearl buttons at a low price, in place of the china abominations prevalent to a comparatively recent date.

Our change from the use of the china button to the pearl one came about through the accidental discovery of a young German turner. While walking along the bank of the Mississippi near Muscatine, Iowa, one day in 1890, he picked up a shell which interested him. In the old country he had made buttons from horn. He was employed as a farm hand; and upon returning home he rigged up a foot-lathe in the barn, and tried it on the clam shell. The button blanks turned out were excellent, and several young women to whom the maker presented them were highly delighted. They were so

Restoring the fish to the water after the baby mussels have attached themselves

bright and pretty, and so much thinner and lighter than the china button then in use.

Spurred on by their encouragement, the young man thought he saw a huge fortune in prospect; but Muscatine in those days was a lively lumber town, and the German, much to his disappointment, elicited little attention when he told of his discovery. Eventually, however, he managed to interest enough capital in his project to get it started. The foot-lathe was found to be too slow for turning out buttons on a commercial scale, so the young inventor set about making a modern button machine. Others joined in, and soon improved cutting machines operated by gasoline engines were perfected, and it was possible to turn out buttons by the thousand.

Muscatine promptly went button-crazy. The huge demand for the new buttons resulted in an army of men engaged in shell-fishing. Day and night the Mississippi for miles north and south of Muscatine was dotted with the shellers' craft. Not only did the fishermen get good prices for the shells, but many of them also found pearls embedded in the mussels, some valued as high as $3,000 to $4,000. The territory around Muscatine became as a mining camp without staked out claims. The river was free to all. Whole towns along its banks awakened to the fact that the clam beds were mines of wealth, and the occasional finding of pearls gave a feverish fascination to the game.

A short time ago, however, the alarming discovery was made that the mussel beds were rapidly giving out. The shell-fish were not reproducing as rapidly as they were being made up into buttons, and the whole industry seemed doomed. Then the Federal Government stepped in and established limitations upon the dredging of mussels in certain streams. Still the supply continued to diminish, in spite of the known wonderful fertility of the parent mussels. So a more careful scientific study was made by the biological experts of the government, and some curious and interesting facts about the life history of the mussel were disclosed.

The dangerous diminution in the supply of pearl button material, it was discovered, was due not alone to the taking out of the mussels, but more particularly to the destruction of fish in the rivers. It was learned that in its early stages of development the fresh-water mussel is a parasite, its existence depending largely upon its ability to fasten itself to the gills or the fins of some fish. Certain species of the mollusks attach themselves exclusively to a certain kind of fish. Thus the niggerhead mussel, one of the most prolific and valuable varieties, is parasitic on river herring almost entirely, and the partial extermination of this fish has a material effect upon the natural reproduction of the mussels. With this and similar information as a guide, the government has established a research laboratory a few miles from Muscatine, and has gone into the business of mussel farming.

There are three distinct steps in the actual cultivation of the mussel. The first is to obtain a quantity of undeveloped infant mussels, which are taken from the mother. A larger number of fish are then caught in nets, and transferred to tanks. The baby mussels, known at this stage of their development as glachidia, are released in these tanks and allowed to attach themselves to the fish. This they do in a few minutes, by means of their spined beaks. After examination has shown that the young shell-fish are firmly attached, the fish are released into the stream.

From this point the mussel undergoes an extensive structural rebuilding. When nearly all its organs are develped, it leaves its host and sinks to the river bottom, there fastening itself to some fixed object and entering upon its life work of growing shell.

Several field parties from the new laboratory are constantly in this work of accelerating the work of of nature, thereby conserving billions of baby mussels which would not otherwise have opportunity to grow up. In the spring, after the heavy floods, there are many overflow ponds near the course of the Mississippi, which are filled with water and fish during the flood, and left isolated as the water recedes. Under natural conditions these ponds dry up, and the fish in them die. The supply of fish in the river is not sufficient to withstand this drain, coupled with that of the market fisherman. In connection with the work of mussel propagation, these overflow ponds are seined out and such fish as are suitable for inculcation of mussels are used in that work. These and all other fish that are taken are then liberated in the main course of the river, thus accomplishing a two-fold object in the reclamation of the fish and the inocculation with the mussel glachidia.

The Weathering of Coal

THE present coal emergency is a problem that will extend into next winter, if the war lasts; and it requires therefore a long look ahead if it is to be satisfactorily met. But to store sufficient coal for a whole winter brings up the question of the weathering of coal during long periods of exposure to the elements. It is generally accepted that bituminous coal cannot be kept for any great length of time without deteriorating rapidly in quality, while at the same time increasing the danger of fires from spontaneous combustion.

Fortunately we have statistics and experiments upon the subject, which show that the deleterious effects depend upon the kind of coal kept—particularly upon volatile components, the presence of occluded inflammable gases in the fuel, and the amount of pyrites or other sulfur compounds. It is proved by these tests that the lignitic, bituminous and semi-bituminous coals have a greater tendency to weather or deteriorate than the anthracites, which contain relatively few volatile compounds. It is also demonstrated that slack coal is more liable to spontaneous combustion and the deteriorating effect of weather than any other. The finer the coal the more accessible it is to oyxgen, and the longer it will hold moisture.

The most notable results of these tests were with regard to coal submerged under water. Such coal showed hardly more deterioration in nine months than in two days. Compared to coal samples exposed to the air this showing is very significant. In the latter case the losses varied from two to ten per cent over a period of nine months. Moreover, the greater loss by far was during the first months of weathering, after which deterioration continued only to a slight degree. In other words, coal that has weathered for a couple of months can just as well be kept indefinitely without further serious loss. To secure the full calorific value the fuel should be burned as soon as possible after it leaves the mine. Of course, this is frequently out of the question; so when large supplies of coal are already on hand, it should be remembered that the older samples have practically reached a stable condition, and will suffer further, if at all, only at such a rate as to make the effect hardly noticeable. It is the new supply that suffers most, and it should be used immediately, holding the old and already weathered coal for emergencies.

In the samples exposed to a thoroughly dry, warm atmosphere under sheds or in other circumstance where the alternate exposure to wet and dry conditions was lessened, the loss was almost as great as in the coal exposed to outdoor conditions. The effect of the moisture in outdoor exposure is so slight that it hardly pays to go to any expense to put coal under cover. The loss directly due to moisture is most noticeable in coals containing a high percentage of sulfur, but even here it is so small as to be negligible in comparison with the loss of volatile hydrocarbons. In other words, weathering of coal is not a leaching process, but a direct giving up of the volatile components.

The effect of the weathering of coal under water was

Seining fish preparatory to infecting them with mussels

determined by submerging it in preserving jars with covers that screwed on, and also in jars the tops of which were held down by wire clamps. The samples held in tight jars showed the least change, but it was found that a gas was given off that would ignite. To make the process of submerging coal perfect, therefore, it would have to be kept in hermetically sealed places, which from the practical point of view is of course impossible.

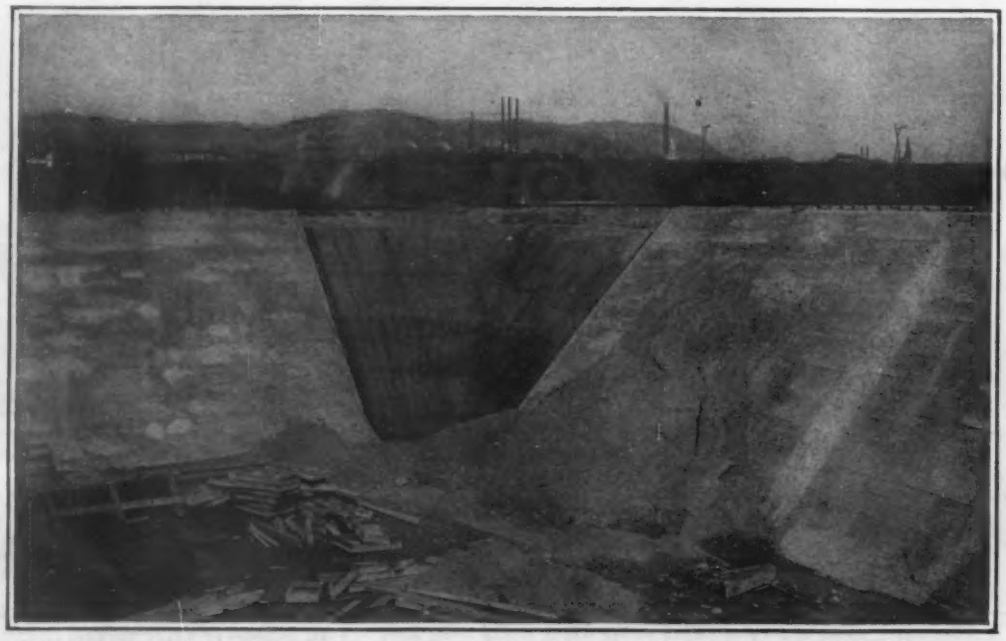
As a result of these studies in weathering of coal, the following conclusions are drawn:

It is distinctly not worth while to construct sheds or covering for coal stored at the surface of the ground. Where there is danger of fires from spontaneous combustion in piles of stored coal, submergence under water practically eliminates the hazard, although ignitible gases may at first escape slowly through the water. But danger from these is relatively slight. As far as actual saving effected is concerned, this is not sufficiently great to go to any great expense in the handling of submerged coal. This is a problem that each coal dealer or user must solve for himself, depending upon the water facilities and the machinery for handling. But where conditions permit of economical operation, it pays to store coal under water soon after it is mined—although not after it has been exposed to the air for a month or two in transit or from other causes.

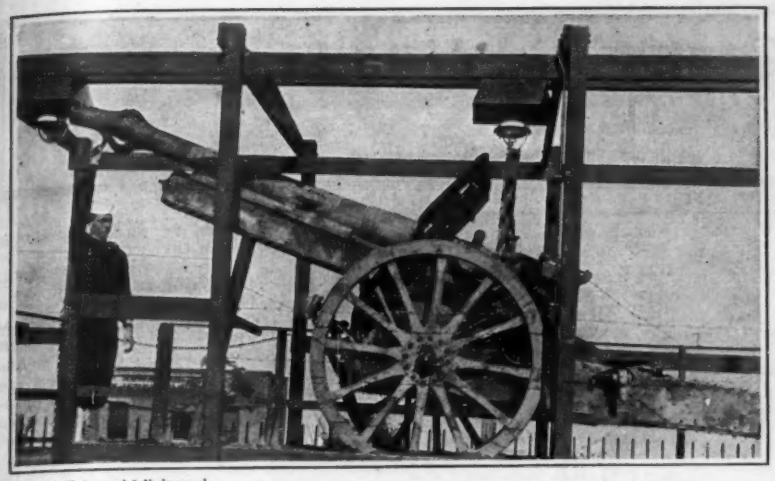
In view of all this, it is not surprising to find that in the bituminous region of Pittsburgh submerged storage of freshly mined coal is being undertaken on a large scale. We illustrate the construction of what, at the moment of writing, is the largest reservoir for this purpose so far built; but of course engineering practice moves so rapidly that we are very likely to wake up some fine morning next week and find that this Brunot's Island reservoir has been relegated to second place or even lower rank. While its leadership lasts, however, be it brief as it may, a few statistics are in order.

This reservoir is 791 feet long, 153 feet wide, and 27 feet deep. It provides wet storage for 100,000 tons of coal. As appears from our picture, this huge hole in the ground is of concrete construction; and over 280,000 square feet of steel was used in the reinforcement. An interesting feature is the use of asphalt at various points in the reservoir to secure a high combination of watertightness and freedom of expansion and contraction.

The arrangement of the steel reinforcement plainly shows in the center of the picture, where the corner of the tank has not as yet been completed.



Pittsburgh's 100,000-ton coal reservoir, where fuel is protected from the elements by storage under water



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German gun with its barrel dynamited before capture

Canadian Official Photo

German naval guns on special carriages, captured by Canadians

Copyright, Western Newspaper Union

Captured German artillery, including anti-aircraft gun

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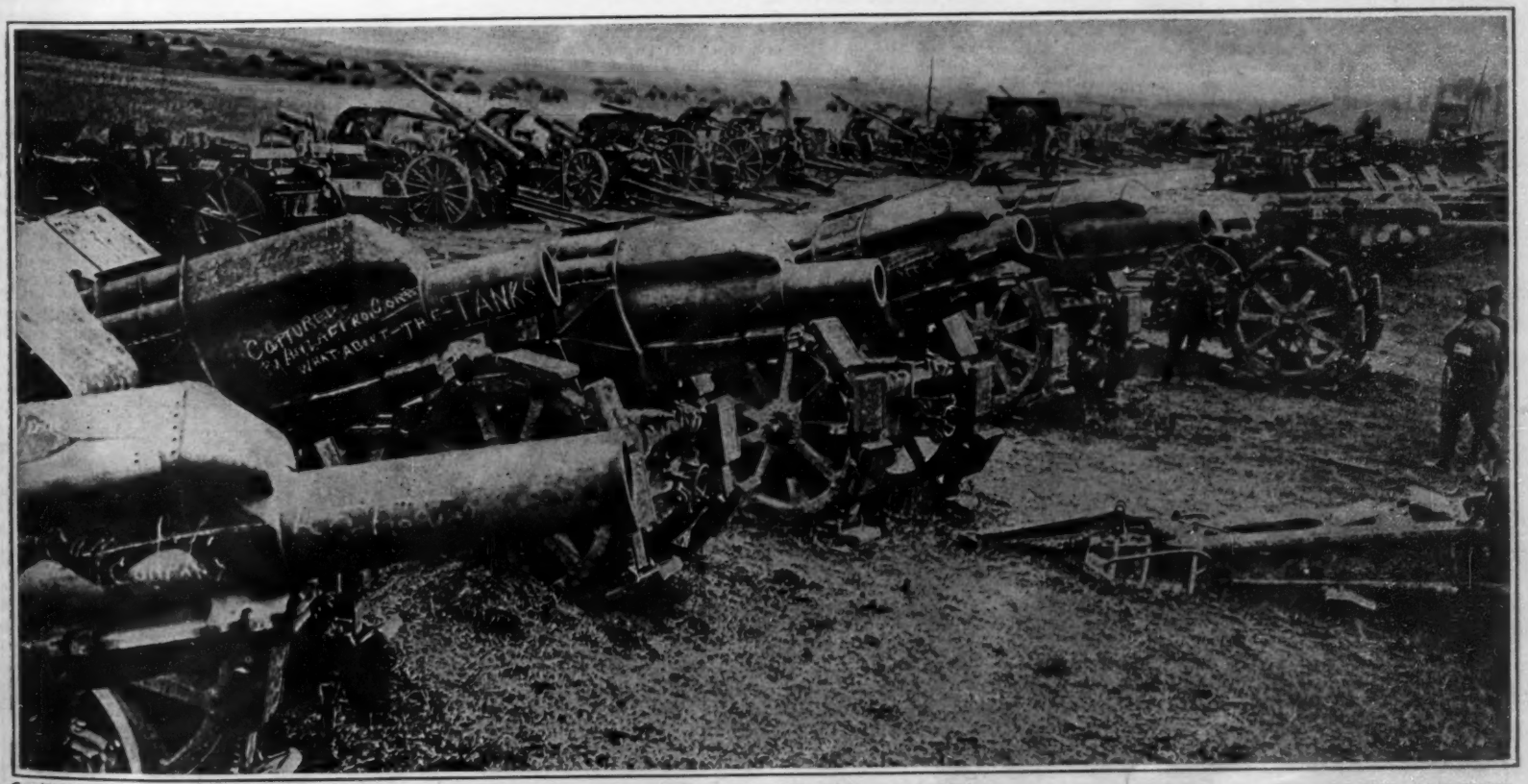
German gun on truck smashed by French artillery

Canadian Official Photo

British removing captured German howitzer and field gun



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Park of captured German field guns and howitzers

THE GERMANS HAVE LOST IN TEN WEEKS OVER 3,800 GUNS. HERE ARE SOME OF THEM

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGÉ, M.S.A.E.

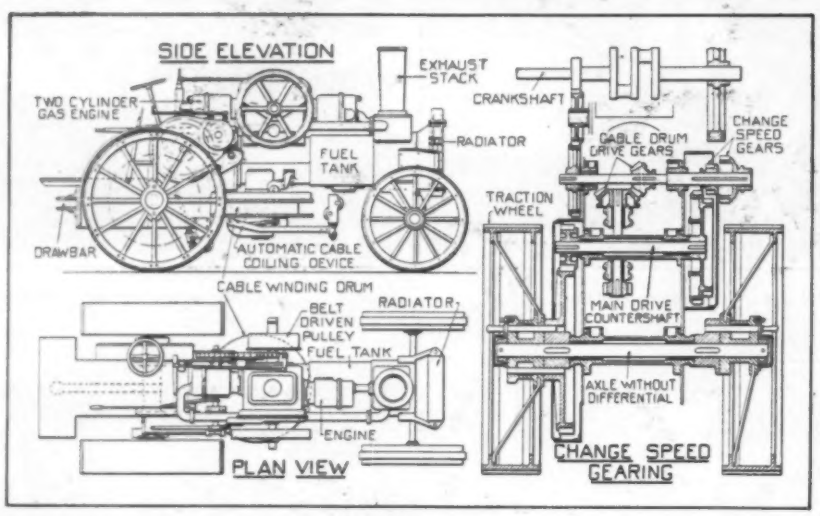
This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Gasoline Tractor for Cable Plowing

IN some of the foreign countries, notably England, mechanical power has been used for plowing in a somewhat different manner than that used so generally in this country. Instead of being hauled directly by the tractor as is the usual American system the plow is hauled by a cable which passes over a winch while the tractor remains stationary. Illustrations of a cable plowing power plant using an internal combustion engine are given herewith. The machine illustrated weighs about 12,000 pounds and has an engine that will develop 35 horse-power at 600 r. p. m. The engine is of the opposed horizontal pattern and has two cylinders, seven inches bore by eight inches stroke. The cranks are set at 180 degrees so the engine is reasonably well balanced. Power is transmitted from the engine shaft to gearing which can be shifted so as to apply the engine power either to the winding drum carried underneath the tractor or to the road wheels, as desired. A brake is provided so as to prevent the winding drum reversing its motion and unwinding the plow pulling cable. The gearing is of the sliding type and reductions are provided so that road speeds of 2.25 and 4.50 miles per hour will be obtained. The traction members are 60 inches in diameter by 14 inches wide and are provided with traction lugs. The front wheels are about four feet in diameter by about eight inches wide.

The internal combustion engine is mounted on the body portion of the tractor, which is of cylindrical form and serves the dual purpose of a frame and a fuel-oil tank, as it provides storage space for 50 gallons of fuel. This barrel-shaped body is about twenty inches in diameter and is made of quarter inch thick steel boiler plates. The winding drum is carried beneath the barrel by substantial plates also of steel boiler plate. The engine is operated with gasoline when first started but after it has been running for a time provision is made so that kerosene may be used, which passes through a vaporizer of the exhaust gas heated variety. Ignition is by a high-tension magneto having an impulse starting mechanism to give a hot spark at low speeds and to insure a ready start even if the large engine is cranked over slowly. The power of the engine is so compounded by the driving gearing that a pull is given to the cable of 3,500 pounds. This is sufficient to drag a four-bottom plow on medium and light land or three-bottom plow through heavy soil.

The winding drum carries 450 yards of steel rope which is coiled automatically by means of a mechanism devised for that purpose. The cable speed is from 250 feet to 350 feet per minute. These engines must be used in pairs, one being placed at each side of the field in order that the plow may be hauled back and forth. It is stated that a pair of such engines can plow from seven to ten acres per day of ten hours, and that they can cultivate from fourteen to twenty acres per day. A special feature is provided in the method of mounting the radiator in order to insure positive cooling. This is mounted at the front end of the cylindrical frame and a current of air is made to pass around and through the flanged tube by means of a draft which is produced by passing the exhaust gases around a large conical nozzle in the base of the chimney and thus secure an ejector action. The barrel-shaped body and use of the exhaust stack gives the machine the appearance of a steam plowing engine. In fact, as far as the cable mechanism is concerned this is the same as used on the larger steam plowing engines. The machine may be used as a tractor as well as for cable plowing. It has sufficient power to haul a weight of eight tons at five miles per hour over level roads. It has sufficient tractive power to haul a four-furrow plow over light ground and of course has more than adequate power for the various cultivators and harrows used to prepare the land for seeding.



Details of an ingenious gasoline tractor for cable plowing, widely employed in England

An Electric Crane Tractor

THE accompanying illustration shows an electric crane tractor, having a maximum gross trailing load capacity of 15 tons, with an automatic type coupler for hitching to trailers. It is provided with a removable battery compartment to facilitate interchange of batteries and a balance drive is used. The crane has a maximum capacity on the hook of 4,000 pounds and it is provided with an electrically operated hoist of the swinging goose-neck type.

It is claimed that as a tractor these electric labor-saving devices meet the demand for all short heavy tractor-trailer haulage on ordinary pavements. They are said to be efficient and economical and have the same advantages as electric trucks. Many haulage problems are best solved by these electric tractors hauling trailers, as they are similar to the industrial trackless trains, which we have already described, but on a larger scale. Such operation is of great value where there is large tonnage to be hauled over short or moderate distances.

It is maintained that the electric transportation equipment has a recognized lessened "fire risk" and for that reason, electric tractors or trucks are allowed by the underwriters to be operated practically without restriction in and about congested terminals, docks and warehouses, where gasoline equipment is taboo. The advantages of the trailer equipment are too well known to require specific mention.

Its uses as a crane are of the greatest importance as a considerable portion of the freight handled by trailers or other forms of transportation, is heavy and unwieldy. Where handled by hand or other slow methods, this has always involved a high labor cost. As will be seen this crane tractor is equipped with a swinging electric goose-neck crane on its forward end by which it is possible to handle unwieldy and heavy or bulky material expeditiously and economically. With the vehicle in an advantageous position, by use of the swinging crane the material is secured, hoisted and transferred to or from trailers, wagons, motor trucks, box cars or convenient piles.

It is declared that practically the only limit of rate of working of this novel device is the speed with which the attaching and detaching operations can be carried out. Material in small quantities is sometimes actually carried on the hooks with the advantage that the delivery point may be the floor, the top of a pile, or the loading space of a box car or truck. The article is placed exactly where desired, and for emergency calls the entire operation takes less time than would ordinarily be required in loading the article on to a wagon or truck. The dexterity with which the various operations can be carried out is proving a revelation to the uninitiated for not only is the time reduced, but the attendant labor necessary is but a fraction of that required by the older methods. This unique equipment is a most effective electrically operated labor-saving device and is being extensively introduced into industrial service.

Farm machine that combines truck and tractor features

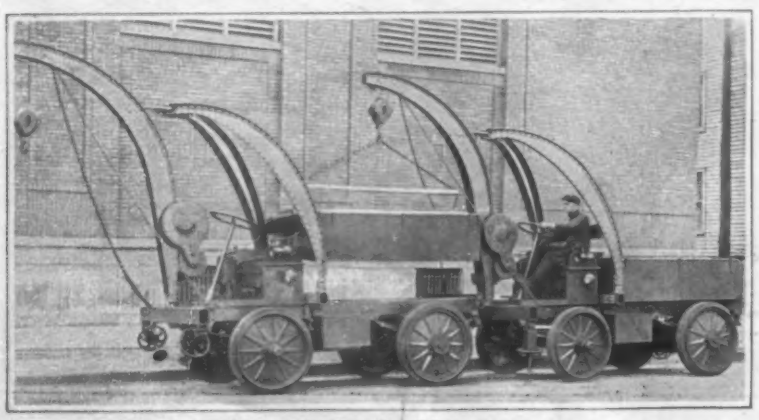
Combination Tractor-Truck

WHILE there seems to be considerable difference of opinion as to the minimum size of farm on which a tractor can be profitably employed there is no question about the utility of the motor truck and no farm is too small to use one of these to advantage. In order to satisfy the demand of those engaged in general farming, even on a moderate scale, the combination of a truck and tractor has been devised by an American motor truck manufacturer that seems to fill the need of a combination machine in an adequate manner. It is provided with steel wheels and while it follows motor truck practice in most essentials the wheels are of larger diameter than the usual truck wheels and also have wide steel rims. A large wagon bed makes it possible to haul supplies or produce over soft roads or through the fields as considerat ly more support is provided by the wide steel rims than would be the case if the conventional double rubber tires were employed. The illustration shows the use of this machine in pulling a three-furrow plow. The driving wheels are provided with traction lugs in order to provide the requisite drawbar pull when used for plowing or disking. These lugs are removable when it is desired to run the machine over the roads.

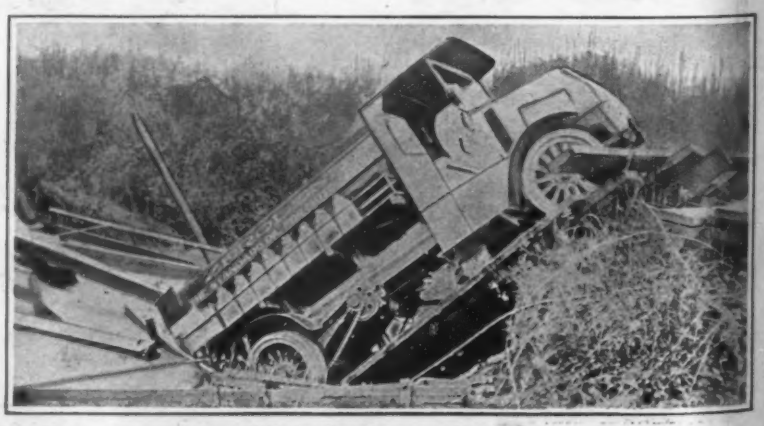
Truck Versus Bridge

LAST week, in describing how the largest locomotive in the world was shipped, we exhibited the wide detour which this monster had to take in order to avoid all bridges that would not support its weight. The problem here displayed was a simple one. The weight of the engine was known, as was the safe limit of load for every inch of the way to be traversed. But if a similar problem came up in a case involving a variable load largely unknown, where the strength of the bridges and culverts to be crossed was not a matter of generally accessible record, the matter would not be so simple.

(Continued on page 327)

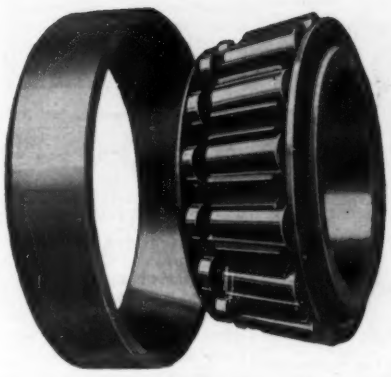


A crane tractor of striking appearance



A weak link in the chain of transportation

Fleet Performance



Do you *know* just what it costs to operate your trucks? If not, we can refer you to a simple, practical and economical way of keeping an accurate and complete record of truck maintenance.

The Maker:

The Autocar Co., Ardmore, Pa.

The User:

S. S. Pierce Co., Grocers, Boston, Mass.

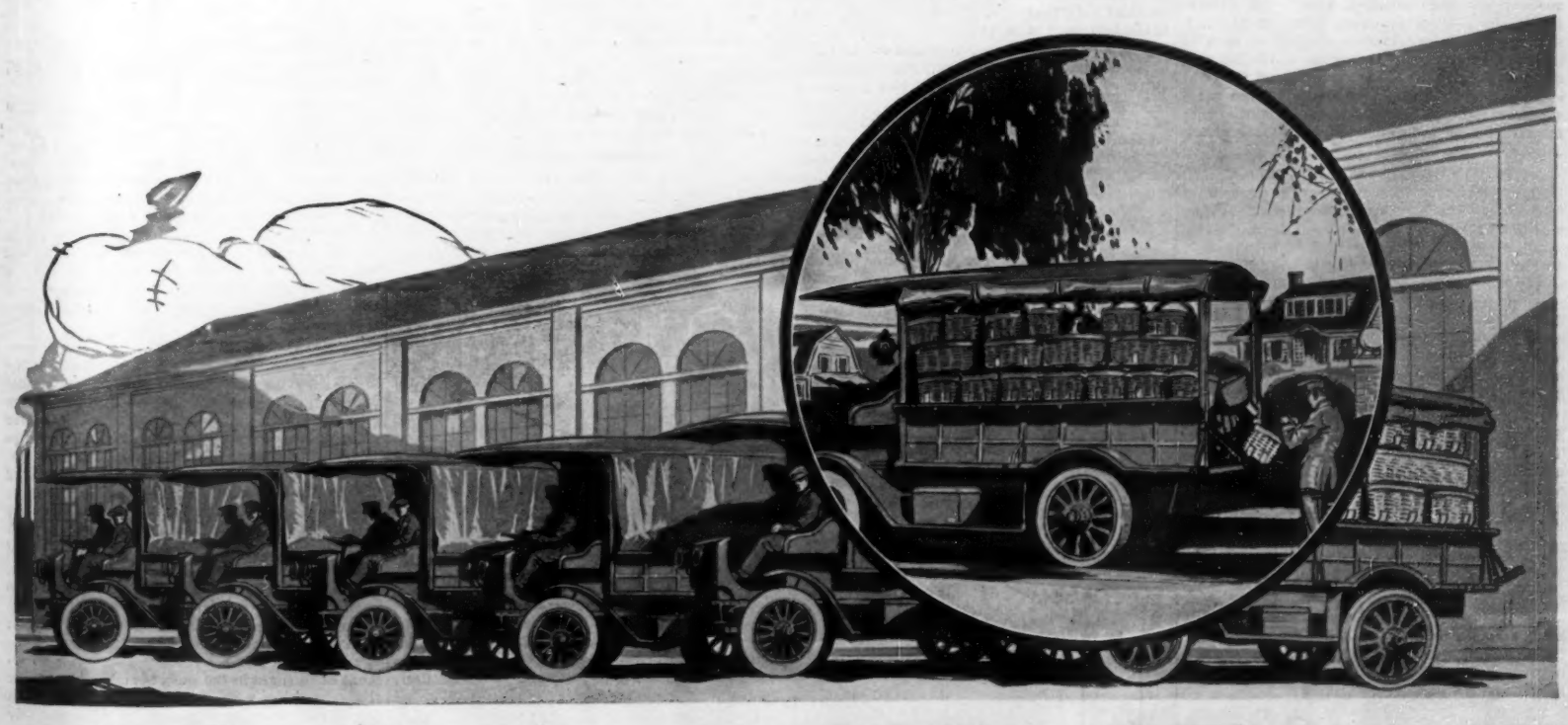
The Bearings:

Timken Roller Bearings in front and rear wheels, at the differential, on the pinion shaft, in the reduction gears, and in the transmission.

The Record:

This company bought its first Autocar in 1912. Each year more have been added, until the purchase of three new ones in 1918 brought the total up to 27. And in 1918 Mr. W. H. Allen of the company wrote the builders that the first car was "still in service and giving as good satisfaction as the new ones." Such performance as this is characteristic of motor trucks with Timken Bearings, not only because the bearings themselves wear longer, but because the take-up for wear permits adjustment that protects other important working parts.

THE TIMKEN ROLLER BEARING COMPANY
Canton, Ohio



TIMKEN
BEARINGS
FOR MOTOR CAR, TRUCK & TRACTOR

RECENTLY PATENTED INVENTIONS

Pertaining to Apparel

OVERALL WAIST.—J. S. ELLIOTT, Box 15, Eddy, Texas. The invention relates particularly to overalls of the type generally known as union overalls, that is, embodying trousers and waist portions which in use at least, are joined together and which may be both put on and taken off in partially connected condition. The invention relates more particularly to the construction of the lower portion of the waist section and the connections between the trousers and waist portions.

CONVERTIBLE CAPE, COAT, AND BLANKET.—L. GOLDSTEIN, 35 South St., Morristown, N. J. The invention relates to wearing apparel, its object is to provide a convertible cape, coat, and blanket, arranged to enable the user to readily don and wear the garment, or use it as a blanket while sleeping. The device is made of a body formed of a single piece of fabric of rectangular shape having a central neck opening and a slit extending from the opening to one end of the body, and midway between the sides, the slit providing an opening for the cape or coat. It can be rolled into a small space for carrying.

BELT LOOP AND BUTTON FOR TROUSERS.—R. J. EWIG care of Ewig Mfg. Co., 68th St. and Fifth Ave., Brooklyn, N. Y. The prime object of the invention is to provide a combined rigid belt loop and button structure which serves at least three immediate purposes as follows, first a stiffener for the waist portion of the trousers preventing collapsing, buckling, or wrinkling of such portion, secondly the provision of a belt loop or guide means for the belt, and thirdly the provision of a button or means to secure the button to the upper portion of the trousers in a reliable manner.

HOSE SUPPORTER.—A. M. WILSON, Cherokee, Iowa. The object of this invention is to provide a hose support arranged for support from the shoulders of the wearer thus relieving the nether garments, corsets or the like, of all undue strain, at the same time insuring the desired ease and comfort to the wearer especially when bending the body or exercising the limbs. A further object is to prevent undue strain on the hose.

CORSET.—LORETA A. CIRCILLO, 202 Bleecker St., New York, N. Y. Among the principle objects which the invention has in view are, to permit greater freedom on the part of the wearer of the corset, to avoid rigid pressures on the legs when the wearer is in a seating position, and to provide an abdominal reducing section, and a brassiere section.

Of Interest to Farmers

CREAM SEPARATOR.—B. PAPKE, 1538 C St., Lincoln, Neb. The invention comprises a base, and a vertical spindle journaled in the base, vertical spindles arranged about the central spindle in a circle at equal distances apart, a separator bowl connected to the top of each of the spindles to rotate therewith, a driving connection between the central spindle and the bowl spindles for rotating the spindles at the same speed, a common vessel for receiving the milk from the bowls, and a common vessel for receiving the cream from the bowls.

AGRICULTURAL IMPLEMENT.—J. S. LYLE, McLoud, Oklahoma. The invention relates more specifically to a seeding apparatus, an object being to provide a seed sowing device comprehending a single structure so arranged that various kinds of seeds may be sown simultaneously, so that at least two rows of seed may be sown, and in connection with the seed sowing device, means are provided for laying the rows at suitable distances. The parts are interchangeable for different kinds of seeds, rough or smooth, large or small, planting one at a time, or sowing broadcast.

HYDRAULIC SIFTING DEVICE.—C. E. P. JULIEN and R. MARGUERAT, Paris, France. This invention has for its object a device enabling to handle a mass and keep it in a condition of equilibrium varying in different positions, and is more particularly applicable in connection with cultivating motor implements. The device comprises a tank mounted on an automobile tractor provided with its digging cutter arranged at the end of a lever pivoted on the cultivating motor implement two positions of different areas and operated by fluid pressure, the larger piston being adapted to be connected with the element to be operated, means for admitting a fluid between the pistons, and a tension device for the smaller piston.

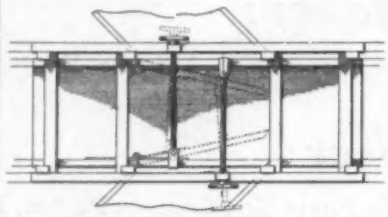
WIRE STRETCHER.—W. A. CAMPBELL, Flora, Ill. This invention has for its object to provide a device for erecting and stretching woven wire and single strand fence wire with ease and rapidity, and wherein a series of grips is provided for engaging the wire, together with means for simultaneously making tension on the grips to tighten the wire.

Of General Interest

WALL PLASTER.—J. E. FAIRFAX, Aiken, S. C. This invention has for its object to provide an inexpensive plaster or stucco which is fire and waterproof, which will not peal off, and which will give a very smooth-finish surface. The base of the plaster is tripoli which being very fine permits the formation of a very smooth surface. The plaster consists of a mixture of tripoli 74.77 per cent Portland cement 24.92 per cent, mineral wood .30 per cent and roasted bluestone .01 per cent.

DIME BANKS.—F. A. SMITH, 141-43 W. Austin Ave., Chicago, Ill. The object of this invention is to provide a device for holding a predetermined number of dimes, so that they will be visible but cannot be removed until the box is unlocked by a particular form of key. In use the coins are slipped into the box, and as each coin is inserted those in front of it are pushed farther toward the closed end of the box.

HEAD GATE.—S. W. SMITH, New Pine, Ore. The object of the invention is to provide a device for use in irrigating ditches, so arranged that a predetermined amount of water may be cut out from a ditch into a lateral, and so arranged

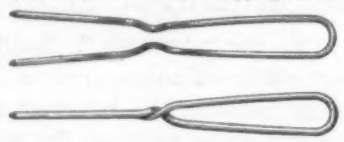


A TOP PLAN VIEW OF THE DEVICE

that the water flowing through the ditch may be divided into three parts if desired. The device comprises a trough having lateral openings, gates for closing the openings at the down stream side, and independent means for opening, closing, and holding the gates in adjusted position.

MOLD.—C. P. HERD, 531 W. Central Bldg., Kewanee, Ill. The invention has for its object to provide a permanent metal mold especially adapted for casting radiator sections. The mold comprises cooperating sections of metal recessed on their inner faces to correspond with the external surface of a radiator section, each recess having a lateral extension at its top for forming a boss on the radiator section at each face thereof and at the top.

LOCKING HAIR PIN.—J. P. BURKE, Struthers, Ohio. Among the objects of the invention is to provide a hairpin having prongs that are adapted to be so interlocked with the strands of the hair as to preclude any reasonable possibility of the pin loosening or slipping out of the



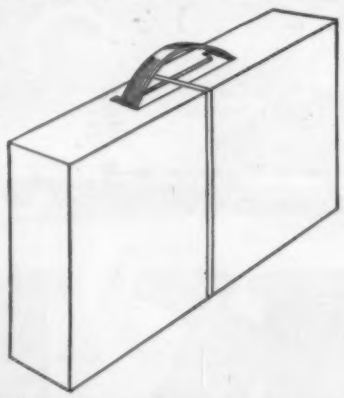
PLAN VIEWS, THE PRONGS BEING SPACED OPEN AND INTERLOCKED

hair. The pin is particularly for use in connection with hair ornaments, the prongs projecting into and thereby holding the device in a lady's hair. The invention is also well adapted for ordinary pins employed for the dressing of ladies' hair.

APPLE CORER.—R. W. RIORDAN, 252 Westminister Rd., Brooklyn, N. Y. A specific object of the invention is the provision of an apple corer having a secondary cutter arranged on the shank of the device at a point inwardly from the tubular cutter and mounted on a lever which is adapted to be pressed by the thumb so that by the turning of apple on the corer and simultaneously pressing on the lever, the seeds and seed cavities will be cut into small pieces which are easily removed, partly by withdrawing the corer and by washing out the core passage with a flow of water.

BURIAL VAULT.—H. D. HORSTMAN, Syracuse, Neb. This invention relates to burial vaults, and has for its special object the provision of a vault constructed of plastic material capable of hardening, the vault being made in sections, which may be assembled at the grave, and by means of which a sealed enclosure for the casket may be provided.

PAPER BOX HANDLE.—C. J. FREESE, 547 Broad St., Elyria, Ohio. The invention relates particularly to a detachable handle for paper boxes. An object is to provide a simple, strong and inexpensive handle for which the box has



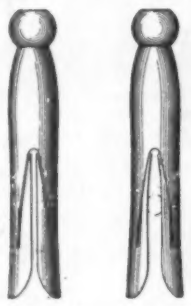
A PERSPECTIVE VIEW OF BOX WITH HANDLE ATTACHED

suitable slits so as to permit a quick attaching of the handle; these slits permit the handle to lock therein automatically, cardboard washers being provided to prevent the handle being pulled through the slots.

POWDER PUFF.—B. H. KARMAN, 122 Fifth Ave., New York, N. Y. The general objects of the invention are to simplify the construction of devices of this character so as to be comparatively easy to manufacture at the same time produce a better made and stronger article. In this device the sewing of the facing material to the back is dispensed with, a grip or finger-hold and means for fastening it in the body of the puff is provided.

ROOF LATCH.—J. S. MURPHY, 355 16th St., Brooklyn, N. Y. This invention relates to forms used in building operations and particularly to what is known as a roof latch, and has for an object the provision of an improved structure which may be quickly applied and removed and which will not easily get out of order. An object is to provide a device formed with adjustable members and a catch member which may be used in either of two positions for holding the adjustable members in an elevated or depressed position for accommodating large or small I-beams.

CLOTHES PIN.—C. BODRI, 2034 Mathews Ave., New York, N. Y. The invention has for its object the provision of a structure which will grip a line properly and without injury to the



SIDE VIEWS OF THE PIN

pin even though the line is carrying an appreciabe amount of clothes. A further object is the provision of a clothespin with cuts on each side of the saw cut for producing resilient gripping tongues.

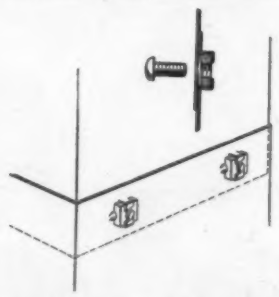
ANIMAL EXTERMINATOR.—N. J. WIGGINTON, Winchester, W. Va. The invention relates more particularly to poison bait holders, the object being the provision of a transparent bait-holder capable of use in the field in such a manner as to avoid all danger of ingress of rain water or of access to the bait by birds or animals other than those whose extermination is desired, only certain animals having free access; the device is simple and inexpensive to manufacture.

INK WELL COVER.—M. A. CROZIER, care of Chas. C. Gill, 253 Broadway, New York, N. Y. Among the principal objects which the invention has in view are to form a self closing cover for an ink well, which does not interfere with the insertion or withdrawal of a pen, to reduce the cost of construction of such a cover, and to supply the same as an attachment for use with ink wells of conventional make.

DISPLAY FORM.—E. T. PALMENBERG, 36 W. 36th St., New York, N. Y. The object of this invention is to provide display forms whereby the user is enabled to readily tilt the body of the form in a forward or backward direction to give the desired pose to the body and to hold the body in the adjusted position In order to accomplish the result, use is made of a socket mounted to turn on the form stand, a bracket mounted to swing on the socket, and a spring tension to the bracket to hold the form in tilted position.

Hardware and Tools

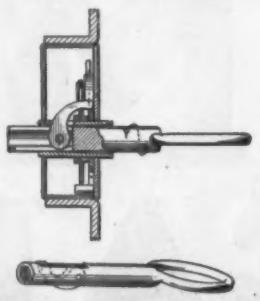
NUT OR RIVET HOLDER FOR SHEET METAL.—J. CRAWFORD, 65—45th St., Corona, L. I., N. Y. The invention has particular reference to means for connecting one sheet of metal to another adapting the same for disconnection



PERSPECTIVE VIEW, AND VERTICAL SECTION

if desired. The prime object is to provide means whereby a man working alone is enabled to rigidly secure two sheets together, the operation being performed from one side of the assemblage without necessitating the operator or an assistant acting upon the other side.

LOCK.—C. E. NORTHROP, 62 Hall Wood Ave., Dayton, Ohio. The object of the invention is to provide a construction which involves the use of a key having a movable member positioned



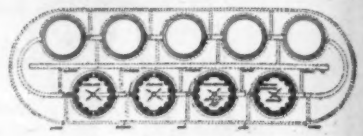
SECTIONAL VIEW OF LOCK AND DETAIL OF KEY

in a particular manner. Another object is the provision of a lock with a bolt and associate parts so arranged that the key for operating the same must be of a certain length and extend to a certain point in a tapering keyhole and a movable member shifted to a correct position by the walls of the keynote when the key is inserted.

Heating and Lighting

BOILER.—P. O. ROTH, 28 Pullis Ave., Middle Village, L. I., N. Y. The invention relates to steam boilers, the object being to provide a construction for causing the water in the boiler to absorb more of the heat units passing through the flues, whereby the flame and products of combustion will be retarded in their passage through the tubes of the boiler according to the adjustment of the retarding means.

KILN.—M. M. MINTER, Albany, Ga. This invention relates particularly to a kiln system involving a circuit of successively operating kilns arranged in a series the prime object



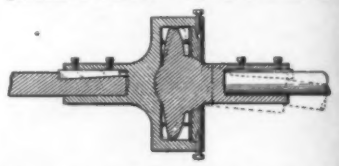
A PLAN VIEW OF KILNS

being to provide a system which may be economically operated, which will be continuous in its action, avoid shut-downs, permit of the burning of different materials in successive kilns, and provide for cutting out of operation any one or more kilns undergoing repair without affecting the action of the others or the system as a whole.

Machines and Mechanical Devices

CALCULATING MACHINE.—M. BARR and R. A. BELL, London, England. This invention relates to calculating machines of the type in which all the partial products obtained by the multiplication of two numbers that can occur within the limits of calculation of the machine whether such numbers be rates, percentages, measures, values, fractional numbers or numbers generally, are stored in the machine.

SHAFT COUPLING.—W. A. FLEEK, Box 101, Douglas, Alaska. The invention relates more particularly to couplings intended for use in connection with propeller shafts. An object is to provide a flexible coupling permitting the



A LONGITUDINAL SECTION OF THE INVENTION

propeller shaft to assume different angular positions relatively to the drive shaft while insuring an effective driving connection as well as an efficient thrust bearing for the propeller shaft at the coupling, means are provided associated with the coupling adjustable with facility to take up wear on the coupling.

DEVICE FOR REMOVING RINGS FROM GLASSWARE.—J. A. LEWIS, 477 Maple Ave., Grafton, W. Va. The invention relates to devices for removing rings from glassware, and has for its object to provide mechanism for use in connection with glass making machinery, for unscrewing the iron rings which are used in the foundation of glassware, for forming the screw threads at the top of the ware. Compressed air is used to operate the device, because of the fact that compressed air is used to operate the blowing machine; however steam or electricity might be used.

POTATO SORTER.—W. T. ROUTSONG, Traverse City, Mich., R. 7. The object of the invention is to provide a potato sorter or grader which is simple and durable, easily moved from place to place and arranged to separate the potatoes into large, medium, and small sizes, free them from sand or soil and deliver them into three different piles, by means of deflectors extending in opposite directions from the large and medium screening means, the small potatoes resting on the lowermost deck through which the sand drops.

MOVABLE EYE DOLL.—H. SEAGULL and O. H. WECHSLER, Majestic Doll Co., 41 Green St., New York, N. Y. This invention relates to dolls having pivoted or movable eyes and commonly known as sleeping-dolls. Among the objects is to so construct the mechanical features of the eyes as to provide a structure giving free movement of the eyes in the sockets and to provide for the eyes being wide open when the head is in erect position or in any position approximately erect; when however the head is tilted rearward the effect of closing the eyes is produced.

Medical Devices

HYPODERMIC NEEDLE.—R. H. RIETHMUELLER, 111 Hudson St., New York, N. Y. The object of this invention is to provide a hypodermic needle arranged to limit the extent of the thrust of the point into the tissues, and in case the needle breaks while inserted in the tissues to permit of readily withdrawing such broken-off portion with a view to avoid a subsequent surgical operation for removing the broken portion.

Prime Movers and Their Accessories

POWER PLANT.—C. B. NAGELMANN, Carneyville, Wyo. This invention relates to compressed air power plants adapted for use in connection with motor driven vehicles. The invention is characterized by the provision of a multistage compressor actuated from an internal combustion engine in which the active cycles are only expansion and exhaust, the intake and compression cycles being part of the work done by the multistage compressor.

(*Continued on page 322*)

More
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Less
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EAT more fish and less meat—as a matter of regular habit. This helps the Food Administration.
Think what a variety you have! And think what a delicious, savory taste there is to a well-baked baby pike, for instance.
Cooking performs miracles for raw foods—and for raw tobacco. "Cooked" tobacco is better. Try Lucky Strike Cigarette—it's toasted.
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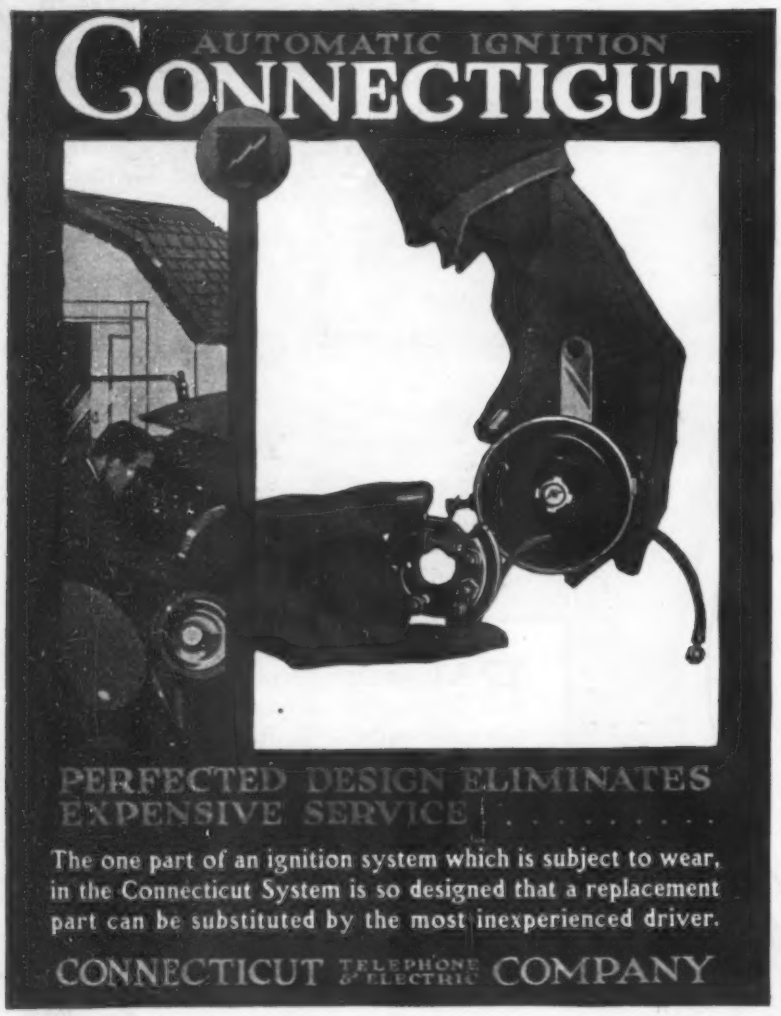
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CONNECTICUT TELEPHONE & ELECTRIC COMPANY

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TYPE L. D.

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Durand Steel Lockers do that; but they are also designed for utmost convenience; they are made of the best materials procurable, by skilled labor; they will last a lifetime or longer; they are fireproof, aseptic, indestructible.

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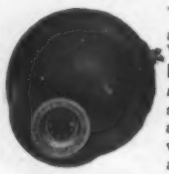

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Write for factory price and free trial offer.

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The Rotospeed Co.
639 W. 5th St. Dayton, Ohio

RECENTLY PATENTED INVENTIONS

(Continued from page 320)

HYDRAULIC MOTOR.—P. VIDELA, care of Club de la Union, Santiago, Chile. The invention relates particularly to a hydraulic motor in which a maximum power is secured from a given quantity of water having a given fall. The object is to provide a construction in which a plurality of turbines are connected to a single supply and are acted on successively by the water until substantially all the power has been secured therefrom.

POWER GENERATING APPARATUS.—E. C. COLLINS, 918 Majestic Bldg., Detroit, Mich. The invention relates particularly to apparatus for generating power through the use of an impact engine, and the production, control, and continuous use of an expansible liquefiable gas as an impact fluid, the object being to provide an effective apparatus which will be simple and inexpensive as well as durable, which will permit of easy control, and which may be erected within minimum space.

CARBURETER ATTACHMENT.—L. B. HARROD, Camp Taylor, 51st Co. 13th Tr. Bv. 159 D. B., Ky. An object of the invention is to provide means for heating the air coming through the air intake of a carbureter, thereby facilitating the starting of the engine. A further object is to provide a carbureter attachment for heating the air prior to its admixture with the vaporized fuel in which the air is forced to pass through narrow highly heated passages, thereby insuring the heating of the air quickly.

SPARK PLUG.—H. G. HORNING, care of Calahan, 502 W. 170th St., New York, N. Y. The object of this invention is to provide a spark plug having a plurality of spark gaps, and arranged to permit of conveniently adjusting the sparking elements to provide a larger or a shorter spark gap to suit existing conditions, and to reduce to a minimum the clogging up of the sparking elements by carbon deposits and other extraneous matter.

CARBURETER.—P. H. HOLTZ, care of General Delivery, Detroit, Mich. An object of the invention is to provide a carbureter suitable for the carburation of air, and it is characterized by means for imparting a rotary movement to the fuel and the air. To obtain this result a carbureter is provided with a plurality of revolvable disks between which the fuel is admitted and also the air to be carbureted. The air helps to break up and to thin the oil between the disks.

Railways and Their Accessories

ROLLER CAR DOOR HANGER.—W. J. ADDISON care of F. M. Parish, Carmi, Ill. The object of the invention is to provide a roller car-door hanger which shall do away with the improper "looseness" of the door when in a dry condition, and with all liability to "stick"

SIDE ELEVATION OF A FREIGHT CAR WITH INVENTION APPLIED

during wet weather, when the lumber swells and causes the parts to bind, in doors of ordinary construction. To accomplish this, above the door are fixed two straight parallel track rods, which pass directly into and through horizontal, parallel, slots, the rods are adjustably mounted in the slots, so that they may be moved nearer to or farther from the sides of the car, the upper track-rod acts to hold the rollers upon the lowermost one, and prevents derailment.

RAILWAY SWITCH MECHANISM.—J. D. ISAACS and C. R. HARDING, address J. D. Isaacs, 165 Broadway, New York, N. Y. The prime object of the invention is to provide means for connecting the head rod to the switch throwing mechanism that shall serve the same purpose with respect to the safety of the rolling stock when the switch stand is on the main line side of the track, as though the stand were placed on the turnout side. A further object of the invention is to provide switch throwing connections which may be installed without necessitating any material change in the main standard equipment.

RAILWAY TIE.—J. B. GRESSETT, JR., Meridian, Miss. The object of this invention is to provide a tie which is composed of concrete, metal and wood, where the rails are supported on wooden blocks, which are independent of the tie so far as vertical movement is concerned, to thoroughly support and cushion the rails, while at the same time without injury to the tie from shock and jar.

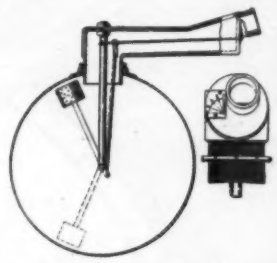
Pertaining to Recreation

WAGON.—S. G. and B. C. PATTERSON, 1816 W. Eleventh Ave., Pine Bluff, Ark. The object of the invention is to provide a toy wagon, wherein a figure is so mounted upon the wagon that it will be moved when the wagon runs. The device comprises a platform, wheels supporting the back end, and a wheel the front end, the platform having slots through which a lever extends, being connected eccentrically to the front wheel to vibrate when the wheel is rotated whereby to move the figure.

Pertaining to Vehicles

TIRE AND FASTENING MEANS THEREFOR.—J. BORYSZEWSKI, Box 78, Forks, N. Y. The invention relates more particularly to vehicle tires made up of separate segmental sections each having a pneumatic inner tube and an air valve therefor. The objects are to provide sections with fastening means adapted to engage mating fastening members on annular tire clamping elements secured to the wheel rim, and to provide wedge means acting on the tire sections at the flaps to effect engagement of the fastening means with the relatively fixed mating fastening members.

TANK FILLER.—G. F. OTTO, 42 Dalzelle St., Detroit, Mich. An object of the invention is to provide an arrangement whereby a tank may be supplied with gasoline or other fuel and the level thereof be constantly indicated at a given point.



TRANSVERSE SECTIONAL VIEW OF TANK WITH FILLER CONNECTED

A further object is to provide a filler for gasoline tanks on automobiles and other vehicles wherein a float is connected with a rotatable indicating finger for causing the finger to assume a proper position in relation to the amount of gasoline in the tank.

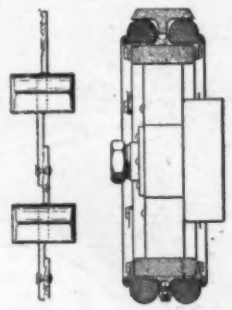
RESILIENT WHEEL.—F. H. D. NEWHARD, 317 Walnut St., Catasauqua, Pa. Among the objects which the invention has in view are to provide a cushioning rim for carrying wheels arranged to withstand the wearing abrasion of the usual traffic. The wheel comprises a central member having a rigid rim, a second rigid rim disposed in annular spaced relation to the first rim cushion means connecting the rims, said means embodying a plurality of springs disposed between the rims to normally maintain the spaced relation thereof.

VENTILATING WINDSHIELD FOR MOTOR VEHICLES.—L. H. WEHRLE, Murfreesboro, Tenn. The object of the invention is to provide means for permitting the lower section of the windshield to be swung inwardly, to provide for a downward current of air and to provide an opening in the dashboard through which air may circulate, a resilient arm secured to the dashboard and extending rearwardly has transverse grooves for engaging the lower edge of the hield section to hold it in adjusted position.

Pertaining to Vehicles

AUTOMATIC SAFETY ATTACHMENT FOR CRANKING DEVICES.—G. H. RICE, Castner, Territory of Hawaii. This invention relates to means for use in connection with the cranking device of an internal combustion engine, more particularly the engine of an automobile or other vehicle, or motor boat; it especially relates to a means for preventing injury to the person turning the crank should the engine back-fire during the cranking up.

NON-SKID DEVICE FOR AUTOMOBILE TRUCKS.—J. GAJAN care of Jos. Krivacs, 27 Brookside Ave., Mt. Vernon, N. Y. This invention relates particularly to a unit adapted to be used in multiple to provide a rigid non-skid tire surrounding the periphery of a truck



A CROSS SECTION OF WHEEL, WITH DEVICE

wheel. One of the objects is to provide article suitable for attachment to the double-solid-tire-type wheel commonly used on trucks, and adjustable to allow for the reduction in size of such wheels because of the wear of the tires.

Designs

DESIGN FOR A TOY HEAD BLOCK.—R. E. HUMBERT care of Baker & Bennett, 573 Broadway, New York, N. Y.

DESIGN FOR STATUE DOLL.—R. MANCUSO, 7 James Court, So. Jamaica, L. I., N. Y.

DESIGN FOR SKIRT TROUSERS.—W. SANDA, 430 W. 122d St., New York, N. Y.

DESIGN FOR A VEHICLE TIRE.—A. J. MUSSELMAN, Chicago, Ill. The design consists of five circumferential bands, a center raised band provided with raised diagonal strips, two bands provided with raised star designs, and two bands of contrasting color. The design is impressed and painted upon the surface of pneumatic tires.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Current Supplement

FEW things are more conducive to the welfare of the human race than a thorough understanding of every phase of bacteriology, and not of the least importance is a knowledge of the result of climatic conditions and temperature. Studies of bacteriological conditions in regions of extreme cold are of special interest, and in this respect the paper on *Bacteria in the Antarctica*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2233, for October 19th, will be found to add considerably to our fund of information as to the varieties existing in these regions, their origin and the cycle of their life history. An interesting phase of floral life is considered in an article on *"Doubling" of Crocuses and Daffodils*, which is illustrated by a number of photographs of unusual excellence. *A Note on Protection Against Aircraft* gives a few facts that may possibly be of interest to us in this country, should the war continue another year. *A Fifty-Year Retrospect* gives an interesting review of naval marine engineering in the United States, and recalls many facts valuable for comparison with conditions of practice today. *How Things Break* is a careful study and analysis of the mechanics of fractures in materials. It is accompanied by a profusion of illustrations. *X-ray and the War* reviews the recent developments of an important science, and considers some of the important applications in medical practice in the war. *Winged Victory* consists of a collection of incidents that give a clearer understanding of the sensational performances of the airmen of the Allies, and the nature of the work they are doing. *Luminous Rockets and Bombs* describes and illustrates a number of devices employed on the battle-front to throw light on the operations of the enemy. *The Low Temperature Carbonization of Coal* deals with the history, theory and methods of a process that the events of the times are bringing into considerable prominence.

Other articles of importance in this issue are *The Evolution and Destruction of Life; Coal and the Cult of the Skin; Chilling and Case Hardening* and *Nitric Acid from Nitrogen Oxide.*

Some Aviation Economics

(*Continued from page 313*)

growth in the war, will unquestionably have a great bearing on the mapping of this country, and both the Coast and Geodetic and the Geological Survey can probably develop an aerial survey which will require a number of planes and aviators and help, to a small extent, in utilizing the output of our factories.

Of the exploration possibilities it is hardly necessary to speak. Some parts of Alaska are yet virgin territory and it is possible that they might be explored via plane, but as a country, the United States has little left to the prospector, even the modern prospector with his aircraft.

If then, army, navy, coast guard, reclamation and mail activities do not altogether provide an outlet for the industry which war has developed, it is easily to be seen that some new means must be found or the existing plants reconverted to other than aircraft uses, with resulting economic loss.

Of such new means, obviously civil transport is the only one which by any possibility could be sufficiency developed to utilize a large number of planes. Many will contend that a forced and hot-house growth of a new outlet, merely to carry on the work of existing factories, is neither good business nor good economics. And indeed, if the supposed civilian aerial transport routes served no purpose but to keep planes and aviators and an aerial establishment busy, its creation would indeed be as uneconomic as the old treadmill in prisons, the theory of which was to provide work for the inmates, not to enable them to produce, but merely to keep them busy.

But it has yet to be shown that aerial transport of passengers, of express and even of freight, is not even now an economic possibility. No one who knows anything of the art of flying doubts that the transatlantic flight is merely not made because every one is too busy flying for war to have time or money to fly for peace. And if the transatlantic flight is a possibility, then a thousand lesser routes are even more possible.

For a time in this country railroads competed with each other to reduce the time between the two largest cities by minutes. The 18-hour train between Chicago and New York paid, and paid well, and would be paying yet were it not that it was actually beyond the peak of continuous possibility—it was calculated only for ideal conditions and when conditions were not ideal it failed. If an airplane passenger route could reduce the time between the two cities to eight hours, so that, let us say, a New York business man might leave New York at 7 A. M. arrive at Chicago at 2 P. M., leave Chicago at 11 P. M., and be back in New York the following morning, is there any doubt that it would be a successful business?

(*Continued on page 325*)

"You Can Mend Almost Anything With This."

B&B

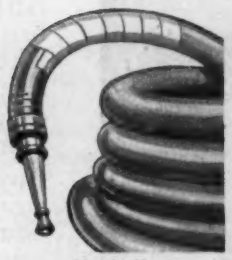
Adhesive Plaster Tape

The Handy Mender

A strong, clinging, rubber-coated tape—almost water-proof. It sticks instantly to anything without wetting, and it stays stuck. It costs but little, and every druggist sells it.

Does These Things

And a Thousand Others



Mends Hose

Patching with B&B Adhesive often doubles the life of lawn hose. Apply when hose is dry.

Even tires and tubes can be patched with it to last at least a while.

It clings to metal, glass, wood, china—anything. So it is used to stop leaks, to seal fruit jars and make labels for them, to mend broken things of any sort.

Use it to stop leaks in automobile tops.

Stops Leaks

B&B Adhesive has a rubber base. So it clings to rubber, and forms a rubber coated patch on rubber footwear or on raincoats. And cloth tears can be mended by sticking B&B Adhesive on the under side.

Mends Rubber

Being rubber coated, B&B Adhesive is an excellent insulator. Wrap wire connections with it.

Insulates Wire

Apply it on articles of any material which you want fastened together. Use in mending dolls and toys.

Forms Grips

It makes ideal grips for golf clubs or for tennis rackets, and an excellent mender when they break. Also perfect protection for hands or heels which are chafed or likely to be.

Prevents Chafing

Don't wet it—just apply it. It will stick. Get it today. Keep a spool always handy. It may save a hundred times its cost.

But get the right kind—B&B Adhesive. It is largely used by surgeons. But millions of spools are now used in the ways we suggest.

B&B

Adhesive Plaster Tape

Sold By Druggists on Spools of All Sizes

Buy 5-Yard Spools For Economy's Sake
Carry One In Your Car

Other B&B Products

All Double-Sure Products are made by masters under ideal conditions. Every B&B article can be relied on.

B&B Absorbent Cotton
B&B Bandages and Gauze
B&B Fumigators
B&B First Aid Outfits

Adhesive Plaster Book—FREE

Picturing 80 uses, and filled with helpful suggestions. Ask your druggist for it, or write us a postal.

BAUER & BLACK *Makers of Surgical Dressings, etc.* Chicago New York Toronto

(067)

965 NAMES ARE LISTED IN PERSHING'S SECOND DAY'S REPORT ON MAI

645 Wounded on the Long Army List; 10 Marines Killed and 138 Wounded

THE DALLAS MORNING

AMERICAN CASUALTY LIST

Day's List Swells Grand Total In Army and Marines to 21,562

NEW ENGLAND MEN ON CASUALTY LIST

KILLED IN ACTION

SEVERELY WOUNDED

THE HONOR ROLL

OVERSEAS CASUALTIES

CHICAGOANS IN LISTS

ARMY

KILLED IN ACTION.

WOUNDED SEVERELY.

4 Californians Are Named in Casualty Lists

Daily Casualty List

ARMY. (Day)

KILLED IN ACTION

MARINE CORPS LOST 87

Our Casualty Lists-

Let's not get used to them—
Let's STOP them—quickly!

HOW? By rolling up an overwhelming subscription to the Fourth Liberty Loan.

After four long, frightful years the tide of battle is turning! The time has come at last when MONEY MIGHT will go far toward hastening the Victory that will *stop* these dreadful casualty lists and bring our boys home again.

Buy Liberty Bonds—*to the very limit of your means!* Never mind how many you have bought already—buy more, and more, and *more!*

Don't think about the money—*that* will all come back to you with interest. Think about the brave young Americans who are fighting and suffering and dying Over There for *you*.

Don't make excuses—make sacrifices!

BUY U.S. GOVERNMENT BONDS
FOURTH LIBERTY LOAN

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The Publishers of SCIENTIFIC AMERICAN

ARMY CASUALTIES TO DATE, 17,269

Marine Corps List Totals 2730 Names, Says Weekly Report of War Department.

3568 DIE IN ACTION

Missing, Including Prisoners, 1435

—Only Five Marines in Hands of Enemy

THE SPOKESMAN

SECTION TWO.

Killed in Action—Sergeants John A. Hobb, Bonanza, Ark.; Clinton Campbell, Clarion, Iowa; Sherldon Cornwell, Thompsonville, Ill.; Paul H. Winter, Monticello, Ind.; William Shoemaker, Lexington, Pa.; Roscoe A. Willard, Mount Carmel, Ill.; Corporals Clarence W. Allen, Mount Pulaski, Ill.; Cornelius Turners Falls, Mass.; George H. Bensenbrook, Hersbourg, Pa.; John C. Bishop, Chesterbrook, Pa.; Carne F. M. Casey, Slocomb, Ala.; Oliver I. Curtis, Ransomville, N. Y.; Fred A. Hays, Seymour, Ind.; Frank Rose, Rock Creek, Iowa; Charles E. Tibbetts, Assonet, Mass.; Thomas D. Way, Union, Salem, Va.; Privates Adelard Sauve, New Bedford, Mass.; Warner, Canada; Frederick L. Pyrtle, Franklin, Pa.

Died of Wounds Received in Action.

Corporal John M. Walker, Wadena, North Dakota.

Privates James J. Bevan, Chicago; Albert B. Danks, Passaic, N. J.; Thomas S. Moffitt, Philip-burg, Mont.

Died of Accident and Other Causes.

Sergeant Arthur Francis, Taylor, Ala.

Wounded Severely.

Sergeants Harry T. Ashworth, New York; Harold H. Hummel, Pine Grove, Pa.; Robert A. Richardson, Grand City, Illinois.

Corporals Ernest B. Mellon, Milton, Mass.; William J. Jones, New York; Edwin A. Reed, Des Arc, Ark.; Arthur L. Thomas, Hiwasita, Ark.

Wagoners Frank N. Clements, Mississippi; Ray G. Dawson, Salem, Ore.

ARMY CASUALTY LIST SHOWS 57 AS KILLED IN ACTION

10 Others Die of Wounds, 2 of Disease, 4 of Accidents, 225 Are Wounded and 7 Missing.

GRAND TOTAL TO DATE IS 17,667

Of These 3631 Have Died in Battle, 1115 of Wounds, 1536 of Disease and 67 in Accidents.

ST. LOUIS POST-DISPATCH

One St. Louisan Killed; Two Wounded in Action

Sunday's Casualty List Also Includes Five Men From Near-by Places—Dead Hero Was a Post-Dispatch Newsboy.

FORMER POST-DISPATCH NEWSBOY, DEAD IN ACTION

AMERICA'S ROLL OF HONOR

Washington, August 14 . . . casualties among the American forces in France reported today by the war department for the army and the navy for the marine corps totaled 179. The army list appeared in two sections, the first containing 1st names and the second 68 names. There were ten marine casualties reported. The army list was divided as follows:

Killed in action, 92; died of wounds, 26; missing in action, 13; died of accident and other causes, 8; died of disease, 10; wounded severely, 24; wounded, degree undetermined, 2.

Total, 169.

This brings the total of army casualties to 18,024, the marine total to 2,760, and the grand casualty total of the army and marine corps to 20,784.

Only three Georgia names were included in Wednesday's casualty list for the army. They are as follows: Killed in action, Private Tom W. Hollis, Forsyth; Private Ernest P. McWilliams, Macon, and Sergeant William P.

Some Aviation Economics

(*Continued from page 323*)

Nor is it at all necessary that it begin immediately to pay from the standpoint of dollars and cents. For years the Post Office has been performing many public services at less than cost. If it pays a profit to carry an ounce of mail 500 miles for 2 cents, it by no means follows that it pays a profit to carry it 5,000 miles for the same 2 cents. If it is profitable to deliver city mail, it by no means follows that all R. F. D. routes are profitable. But the postal establishment *as a whole* is upon a profitable basis.

The United States now operates and to all intents and purposes owns the railroads. Whether it will ever give them up again to private ownership and competition is a matter which cannot be gone into here. But supposing that it does not, is there any reason why the extra profit on the standard railroad haul should not pay the loss on the airplane haul, until said airplane haul estat lishes itself as a profitable line?

There is no doubt that the development of the huge bombing machine, capable of carrying much weight and many men, will merge into the development of the large, comparatively slow, passenger-carrying plane. The New York-Chicago route is but one of thousands, for while it is not likely that smaller centers will be soon connected with mail planes, carrying letters at 12 cents an ounce, it is easily conceivable that they will be connected with planes, carrying *both* letters at 12 cents an ounce and passengers at anything from 2 to 10 cents per mile. On such a basis (10 cents per mile) 20 passengers would pay $1,600 for a New York to Chicago flight, and if 500 pounds of mail were carried in addition at 10 cents an ounce, the gross income from one flight would be $2,200, which would very soon wipe out the original investment, pay a handsome profit, and reduce taxation.

These are not idle dreams. We have the industry. The war is going to stop some day. We must do something with that industry. What else can we do than establish that straight line transportation for which the world has waited since the beginning of time?

Of course, there are a thousand problems to be settled in connection with a government use of a government-created industry. We must have landing fields, a large number of them. They must be properly graded, marked, identified. Aerial routes must be laid off, and marked. Vertical or slanting searchlight beams of various colors and motions must form lighthouses of the air, as the various colors and motions of lights in lighthouses on the coast protect and guide the mariner off shore. In a government controlled industry of such a character, a very definite program must be laid out for experimentation and for the utilization of all improvements, and the compensation to inventors for all inventions, which extend the service. Up to the present era, the country which is the very mother of invention itself, has offered less inducement to her inventors to invent than any other nation. It is that stupid policy of "hands off" which brought our country into the war most of all unprepared in aviation. We invented the flying machine—and Europe grabbed it and developed it. We sat back and said "Let the inventors and the promoters and the public work it out for themselves."

Such a condition is unthinkable in that future when the entire airplane industry is as much a governmental activity as the Post Office today. Today no man makes a postal invention with any idea that the government will help him develop it—but mail is, after all, not a mechanical or scientific matter, subject to much inventive development. The airplane is. We stand but at the threshold. The hovering plane, the plane which can land in a back yard or on a roof, the successful motor weighing less than a pound per horsepower, the truly efficient propeller, the apparatus which makes navigation as easy in a fog as in sunlight, the automatic pilot—these and a host of other developments lie just outside the range of present day knowledge. It will not do for the government to rely on the existing system of invention, patent and development for improvements to the planes and the service it will control. This, perhaps, is as vital a problem as any connected with the utilization of the war-created industry, and one which can well engage the careful thought both of politicians (using the word in its best sense) and of economists.

Lest some reader accuse me of a less than practical and more than visionary viewpoint, let it be said that the present state of the art of flight, with all its wonder-promises for the future, does not as yet warrant any thought that the aircraft will ever supersede either the truck, the pleasure car, the railroad or the liner. We still use horses in spite of the automobile. We still use stages in spite of the railroad. We still use sails in spite of steam vessels. The wires are no less busy now that we have wireless, the mail is no lighter now that we possess telephones. Each has its place. So will civilian aviation have its place, and its place will be a new one, not a filching from other transportation means of their usefulness.

Now, of course, it is possible, if dreadfully disconcerting to contemplate, that men of little vision will say: "Let us reconvert our airplane factories after the war. Let those which were once piano factories again make pianos. Let those which were once manufacturers of automobile bodies go back to making bodies. Let the workman trained and skilled in making wings, fuselage, instrument, work-controls, spars, dope, propellers, go back to the things they did before the war. Let us scrap the industry as we will scrap the army. No one thinks that after the war we will keep five million men under arms; why should we keep a hundred thousand a year airplane production industry going?"

But it is to be hoped that this will not happen. The men relieved from soldier duty will find their places again in civil life after a while. But they are always soldiers and that great army, even if sent back to desk and home, could be remobilized in a short time. But your airplane industry, once dismantled and reconverted, could not be again revived without the same wild expenditure, the same organization difficulties and the same delay which has characterized its establishment—which, in spite of our hopes, could hardly have helped characterizing the establishment of anything so vast in so short a time.

This article would fail of its purpose if it did not emphasize the one point which will save to the country one of the greatest assets the war will have given it. The matter is entirely one for public opinion to settle. In the long run, the government does what the country wants. If the country wants continued railroad operation and management, even ownership, by the government, the country will have it. When the country wanted a Panama Canal, the country got it, politics to the contrary. If the country wants the airplane industry continued as a government function, the country will have it. Hence it is not too early to think of these problems, to devote time to their solution, and to make ready the answer against the time when we will find ourselves with a gigantic industry on our hands, and but two things to do with it—scrap it and waste it, or use it, in the only way so immense a thing can be used, by the power of the state.

Salvaging the St. Paul

(*Continued from page 315*)

to the keel of the vessel in order to put the rolling cables and gear in place. In addition to removing the top weights of the ship, as much mud as possible was removed from the interior before the first rolling operations.

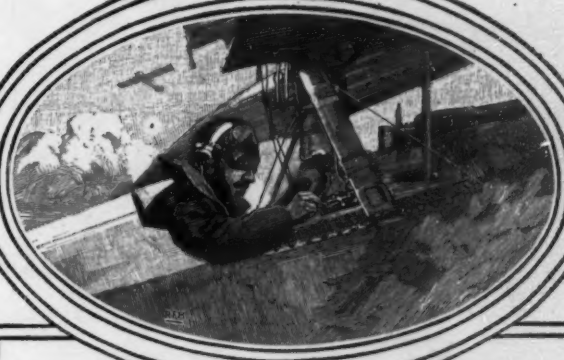
It was decided to lighten the ship as far as possible by pumping, and to this end the forward and after holds of the ship were closed watertight. This involved the closing of No. 3 hatch with a massive sealing of concrete, which was fully two feet in thickness. The water in the fore peak was expelled by compressed air, but all the remaining water was removed by pumping. These pumping operations were necessarily very elaborate; 22 pumps with discharges from 4 inches to 12 inches were employed, including three centrifugal 12-inch pumps. Steam to run these was supplied by a 4-inch steam line, which ran along the edge of the top deck, with manifolds at suitable places for connections. There was also an air-supply line along the upper side of the ship with connections to the various air compressors. Portable blowers were erected on the sun deck for expelling gas from the holds, and an electric generator for lighting purposes.

One of the difficulties met with in pumping the "St. Paul" was the drainage of the large number of compartments. Dynamite was used to break through some of the restraining walls, but the most satisfactory results were obtained by the use of an underwater cutting device invented by two members of the salvage force and here used for the first time. Twelve holes were cut by this method to allow the water within the ship to drain to the large pumps.

The rolling operation was started on July 22d and continued until July 28th. During the first day the "St. Paul" was rolled from a list of 73 to one of 36 degrees; a gain of a little less than two degrees was made each succeeding day, until the rolling operations were suspended on the night of July 28th; by which time she had come back to a list of 27 degrees.

The Second Stage

The pontoons were now taken off and the work of completing the closing up of the entire vessel was started. For this and other work as many as 22 divers were employed on the busiest days. They had to go down and not only close the port holes but also close up the scupper connections and certain outboard connections. One of the most serious of these operations was the placing of a patch over an ashport opening, which was buried nine feet under the mud. This patch was elliptical,



Aviation wireless! Its *great speed* is even outmatched by the Mimeograph—for while the wireless is sending one message to one receiver, the Mimeograph will start hundreds on their various ways. Fast? While the Mimeograph duplicates the typewritten or handwritten page with a sharp exactness that practically makes every copy an original, its remarkable advantage is the *rapidity* of its execution. Simply click off the message on the typewriter and it is ready to print—five thousand an hour. Diagrams, illustrations, plans, etc., may be quickly traced on the same stencil—and duplicated in the one operation. Get new booklet "A4" from A. B. Dick Company, Chicago—and New York.

MIMEOGRAPH

Motor Trucks in America and Over There, are doing great work towards winning the War. This photograph shows a Riker Truck owned by the Midvale Steel Works and in constant use at that great plant

RIKER

TRUCKS

ARE

BUILT BY

THE LOCOMOBILE CO.

OF AMERICA · *Bridgeport, Conn.*

Unarmed Arms of the Service

Men from the battle front who have been holding the line for months and years complain of the monotony of war. The soldier's life in the trenches soon ceases to be a novelty and becomes a tedious routine.

The morale of the army is of supreme importance and the greatest military authorities of the world are enthusiastic in their praise of the organizations which make it their business to keep the soldier in good spirits.

This work, like that of the Signal Corps, has been more highly developed in this war than ever before. Huts for amusement, comfort and recuperation of the fighting men are in the trenches as well as behind the lines. The unarmed workers go about their duties under shell fire as coolly and as self-forgetfully as the telephone men of the Signal Corps who are frequently their neighbors, and who keep intact, often under a hail of bullets, the indispensable lines of communication.

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measuring 18 inches by 28 inches. It was formed with a circular armhole, through which the diver was able to insert the bolts, afterward screwing them upon the inside and then fastening a supplementary patch over the armhole with stud bolts. Altogether some 500 openings had to be closed by the divers throughout the ship.

In order to increase the righting effect a great system of cofferdams was constructed, including one about hatch No. 1, and a cofferdam about hatches No. 2 and No. 3, which was connected to form part of the main cofferdam (all these, of course, on the port side of the ship). The main cofferdam extended from forward of the bridge to six feet aft of the after end of the engine room. There were also cofferdams over hatches 4, 5 and 6. The main cofferdam was flush with the port side of the ship and was brought to above water level. Its total length was 270 feet. Also, on the starboard side the alleyway on deck No. 2 was closed in by a wall of three-inch, tongue-and-grooved planking, the total length of this work being 294 feet.

The second stage was one of pumping and rolling the ship, and the work was assisted by the derrick "Monarch" lifting on the chains which had been used by the after pontoon and by the derrick "Commander" lifting on the chains which had been attached to the forward pontoon. The combined effect of the pull on the A-frames, the lifting of the derricks and the pumping out of the cofferdam and the forward and after holds, served to bring the ship from 27 to 16 degrees of list. The second stage was completed at this point.

The A-frames were then removed from the starboard side and 600 tons of rock ballast was put into the "St. Paul," 250 tons of it being placed in hatch 4 by chute, so that it lay from the midships to as far out on the starboard side as possible. One hundred tons was put through hatch No. 2 in the same way, and 250 tons was placed through a coal chute (reinforced for this work) into the forward starboard coal bunker.

Third Stage

The third stage of the work consisted in pumping out the entire ship and steadying her by means of the derricks "Monarch" and "Commonwealth" on the port side, and the derricks "Commander" and "Chief" on the starboard side. The "St. Paul" first righted up to about four degrees of list, and then, approximately five hours after the starting of the pumps on September 11th, she was floated forward and aft.

As everything movable within the vessel had fallen over to the port side, the vessel continued to keep a list of from three to five degrees during the final pumping operations, which continued for two weeks; during which time, as the vessel floated higher and higher, weights and sections of cofferdam were removed from the upper part of the wreck and mud and wreckage removed from the port side of wreck, starting on the upper deck and gradually working down, day by day, to decks No. 2 No. 3 and No. 4. When it was seen that vessel would still hold a definite port list 305 tons more ballast was put in hatches No. 1 and No. 2.

Workmen were then placed on the ship for cleaning and renewing winches and other parts of the ship's machinery on August 28th, and on September 12th additional gangs were put on this work. On September 27th representatives of the American Line formally took over the ship from the salvors.

Capt. I. M. Tooker had charge of the work, as superintendent, with Mr. Ralph E. Chapman as salvage engineer. The work was done in consultation with the engineers of the American Line, and to these gentlemen the SCIENTIFIC AMERICAN is indebted for many courtesies extended during the preparation of this article.

A Successful Cotton Picker

(Continued from page 315)

Each one of the five picking nozzles and rubber pipes is handled by a man, and the speed of action depends on the skill he acquires. A single sweep of the patent nozzle across a row of the white blossoms is alleged to pick them clean, the time being about that required to pick one boll.

The rate of picking cotton by hand seems to vary from 100 to 200 pounds per day—the record being made by a colored person who picked 900 pounds in a day but did it on the run, and without attempting to do more than to get the easiest reached. Also cotton pickers are wasteful, the waste running as high as 50 per cent of the crop, and the amount, according to the Government reports, running into hundreds of millions. It is human nature to pick the bolls on the top, and to let those lying in the back-breaking strata at the bottom of the bush remain to sleep in the southern sunshine.

The persons running the California machine, described and illustrated, claim that five men with the machine can pick 1,000 pounds per man per day of ten hours or 5,000 pounds per day, and that it does a clean job instead of a wasteful one, because

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the nozzles do not mind being required to get down into the bottom of the plant.

There remain plenty of woodpiles for the Ethiopian to hide in and it may be that the machine without brains, even though directed by human hands at the very nozzles, will still not pick with the proper discrimination, but the fact remains that this is the first one on record to reach even the present stage of hopefulness.

As cotton authorities allege that last year not far from a million persons were engaged in the harvesting of cotton, the machine able to do the work of five times the number of men needed to operate it, and to do it with little labor on the part of the crew, might well be an invention of serious national need.

Truck Versus Bridge

(Continued from page 318)

With the increasing use of our highways for heavy motor-trucking, this puzzling issue is one which is more and more frequently met. If all the factors were known, it would be practicable to make a safe detour. But seldom are they all known; and it goes without saying that a wide detour is not the most satisfactory means of dealing with the problem of adequate bridges. Yet the bridges must be adequate for the traffic that goes over them, or some such casualty as the one we illustrate is invited. Before the last chapter can be written in the story of motorized freight traffic that is now being unfolded, it will be necessary for our county and state highways officials to consider with care whether their bridges are up to the mark, and for our shippers to ask themselves seriously just how much load a common road can properly be asked to support. Some sort of a compromise has got to be reached; and the sooner the better, else the country-side will be strewn with the corpses of bridges and trucks.

Quantitative Spectrum Analysis

A NEW branch of pure science, described in the above caption, has recently, like so many others, proved of considerable value in technical application. Qualitative analysis has long been familiar, but it is only now that the possibility of making the spectrum yield quantitative results has been made apparent. The new method is being used with complete success for the determination of very small amounts of extraneous material. It is accurate within less than ten parts per million, and will readily be seen to fill a long felt want in many metallurgical and chemical processes.

The process is available wherever the base substance to be tested has a higher boiling point than the impurity at which the test is aimed. It rests upon the evident fact that if an electric arc be formed having for its positive arc a sample of the substance to be tested, the spectrum of that arc will show the bright lines characteristic of any and all impurities present. But as the temperature of the arc is well above the boiling point of any of these impurities, they will boil out more or less rapidly; and as they do some these bright lines will get dimmer and dimmer, until, with the disappearance of the last trace of the element which they characterize, they will themselves disappear.

Now, of course, the base of the electrode is boiling away, as well as the impurities. So the time which it will take the impurities to boil out completely is not dependent merely upon the percentage in which they are present; it is also dependent upon the weight of the electrode to begin with. But it is dependent upon these two factors, and nothing else. So the operator has only to observe with a stop-watch the number of seconds which elapse between melting of the mass and disappearance of some particular spectrum line identified with the impurity in which he is interested, and the thing is done. A scale will have been established by tests in which the weight of the sample and its extraneous content are known, and the time determined; and from this scale the percentage of impurity will be easily fixed when the weight and the time are observed.

In practice, it is found convenient, not to observe the time required for the complete disappearance of the line upon which attention is fixed, but rather the time in which it fades to a point matching up with some other line—presumably a carbon line which must be present in a constant brightness. Thus, in determining the percentage of lead present in copper, the brightest visible lead line is selected, this being in the violet between the two bright copper lines 405.29 microns and 402.29 microns. Since this lead line falls in close proximity to the first line of a carbon band, it is referred to that line, and the time measured between melting of the electrode and exact matching of the lead line with this carbon line. An ordinary stop watch develops sufficient accuracy for the work.

The positive electrode, which is going to melt, has of course got to be set up in such a way that it will not run away. It is accordingly placed in a graphite cup. At first a stationary electrode was used opposite it; but it was found that rotation of the upper electrode steadies the arc materially and holds the focus on the

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spectroscope slit, so that after starting the arc requires no attention. The size of the sample which will give the best results depends, of course, in great measure upon the arc and the current; with given conditions in this field, it is obvious that larger samples will increase accuracy, especially with low percentages of the extraneous material. An idea of the time necessary for a determination may be got from the statement that when the lead line is caused by the presence of 0.004 per cent lead in a sample of copper weighing 0.2 gram, it fades to the level of the carbon line in 14 seconds; if the sample is one gram in weight and contains 0.038 per cent of lead, this time increases to 277 seconds.

The method is of considerable utility. In the remelting of copper scrap, the bath must be worked until the lead, which is introduced by pieces of lead-covered cable, is below a certain fractional per cent, depending upon the use to which the copper will ultimately be put. Again, the zinc sulfate solution from which electrolytic zinc is made must be free, among other things, of cadmium. Chemical determination of cadmium takes so long that before a report can be had the solution will have been electrolyzed and the damage, if there be any, done. The method has also been applied to the determination of coloring matter in wines, to the detection of blighted wheat flour, to the location of ntrates in water and of phosphorus in cases of suspected poisoning, and in the analysis of sugar and essential oils.

Test Without Destruction as Achieved by the Permeameter

OUR tests for the physical properties of materials have long been open to the objection that they destroy the sample tested. We find out what the elastic limit is by stretching a bar until it refuses to return to its original shape. We discover what pull a substance will support being pulled apart by pulling it apart; we learn what pressures it will stand without being crushed by crushing it; we inform ourselves of its ability to withstand any kind of destruction by destroying it in the manner prescribed.

This all very crude. It places us at the mercy of errors in sampling, since we can never test a piece and then use it. For the same reason we have no remdy and no preventive for irregularities in manufacture—except the unsatisfactory one of testing, and thereby destroying, a greater percentage of the output. It is possible for us to apply only a very limited number of tests to the exceptional tool or part which has been discovered by accident among a quantity of ordinary pieces; and we are so prevented from getting a complete insight into the reasons for the unexpected excellence.

If we are to do away with the test by destruction, however, we must discover some physical property of matter which varies in demonstrable manner with the properties of tensile strength, hardness, elasticity, etc., and which at the same time can be measured directly without impairing the material. If such a property be found, we can, by measuring it directly, measure indirectly the properties in which we are really interested, such as those named above.

It has been established that magnetic premeability bears a definite relation to hardness, tensile and elastic strength, and other qualities which are of importance in structural materials and tool metals. With this point of attack, it becomes possible to carry out the program outlined above, and test for these primary properties by measuring the property, secondary in direct importance, of magnetic perme ability. Moreover, the new method has great advantages over the old, aside from its lack of destructiveness. For the permeameter has been developed to the point where it shows, not merely results *in toto* for a given piece of metal to which it has been applied, but actually reveals the local conditions throughout the piece, showing whether it is uniform in structure, localizing the weak points or zones, and revealing irregularities or defects which would have remained unsuspected under the old order of testing. A metallurgical technique of great importance is thus opened up, which is being applied more and more widely to replace the old methods of testing by destruction. Those who are interested in the details of the subject are referred to Scientific Papers 272 and 306 of the U. S. Bureau of Standards.

Proposed New Commercial Highway for Europe

THE Mittel-Europa ambition which causes Germany to look with emotion upon the promise of through routes held forth by such slogans as "Antwerp-Bagdad" and "Berlin-Tabriz" has produced in France a counter movement which aims at providing Switzerland and the central Hinterland of Europe an Atlantic port, rendering them economically independent of Germany. This project is arousing special interest at Nantes, whose municipal authorities are conferring with Swiss commercial interests with a view to joint action. The business men of Lyons are watching the movement with interest, but apparently have not yet been able to choose in their own minds between the several claimants for the position of tidewater terminus.

The project lines itself up well with the more familiar one of linking the Rhine and the Rhone by canals that would connect each of these rivers with the navigable lake system of Switzerland. It is thought, however, that both enterprises must be preceded by railroad building having the same ends in view. On this score the Loire region would seem to possess notable advantages over other contenders. Reference is especially made to the easy grades and absence of curves, to the fertility of the region traversed, and to the manner in which the terminal port lends itself to the introduction of a free customs zone, which might incidentally become the headquarters of a considerable remanufacturing industry.

In the matter of comparative distances, we quote the following table from a Nantes daily:

Distance from	To St. Nazaire	To Nantes	To La Rochelle
	Miles	*Miles*	*Miles*
New York	3,063	3,093	3,118
Colon	4,496	4,526	4,534
Rio de Janeiro	4,853	4,883	4,857
Buenos Aires	5,943	5,973	5,947
Cape Town	5,748	5,778	5,752

Distance from	To Pauillac	To Bordeaux	To Havre
	Miles	*Miles*	*Miles*
New York	3,162	3,187	3,130
Colon	4,566	4,591	4,607
Rio de Janeiro	4,876	4,901	5,077
Buenos Aires	5,966	5,991	6,167
Cape Town	5,771	5,796	5,978

Of interest in comparison are the distances from New York to leading European ports under existing dispensations: to Liverpool 3,010 miles, to Southampton 3,100 miles, to Antwerp 3,325 miles, to Hamburg 3,455 miles. It is suggested that after the war American passenger and freight traffic with central Europe as well as with France will tend toward the Loire in preference to the Channel and North Sea ports, which are more distant and which, owing to their location and climate, disproportionately increase the cost of navigation and insurance.

One disturbing factor which those interested in the project seem to have overlooked is the disposition to be made of the several immense ports built in France for the use of the American military machine. It stands to reason that these will be neither demolished nor abandoned with the coming of peace, and that they will have a material influence alike upon present commercial arrangements and upon any readjustment of these which may be attempted.

Shanghai's Bamboo Organ

AFTER 50 years of service the bamboo organ in the Church of St. Francis Xavier, Tungkadoo, Shanghai, is still in fairly good condition. It is stated that there is one other bamboo organ in the Orient, but it is not possible at this time to secure definite information relative to its whereabouts or condition. As metal pipes are to replace the bamboo in the Shanghai organ, the noted instrument will lose much of its public interest.

In a recent issue of the *North China Daily News* of Shanghai, the following comment appears regarding the tone of the historic bamboo organ:

"It would be better if it were completely in tune, for a long wave beat, similar to the short one which gives the beauty to the tremulous vox coelestis betrays the fact that it is not. Possibly it never was, for bamboo does seem refractory stuff for organ building. Despite this, however, the tone is sweet, if somewhat 'woolly,' and the whole instrument speaks volumes for the skill of those men who, using only materials immediately at hand, were able to devise an organ pleasing to the ear and able to defy the severest test—that of time."

Platinum to be Declared in France

A LAW has recently been passed in France which requires all holders of platinum over 100 grammes to make a statement of the same before a prescribed time. This measure may be followed by a requisition with due payment of the value of the platinum, for it is now indispensable in the manufacture of explosives for shells and the like, all of which employ nitric acid as a base. During a preceding period, Chile nitrates were used as a source of the acid, but as this importation took up a large amount of tonnage and it was desired to use the vessels for other purposes, it is now preferred to use the synthetic process for nitric acid and make use of home materials. In this process—used also by the enemy, hence the requisition will act to prevent leakage into those countries—nitric acid is obtained by a proper combination of ammonia with atmospheric oxygen. The ammonia used here is manufactured by the well-known processes, especially by the use of carbid and cyanamide.

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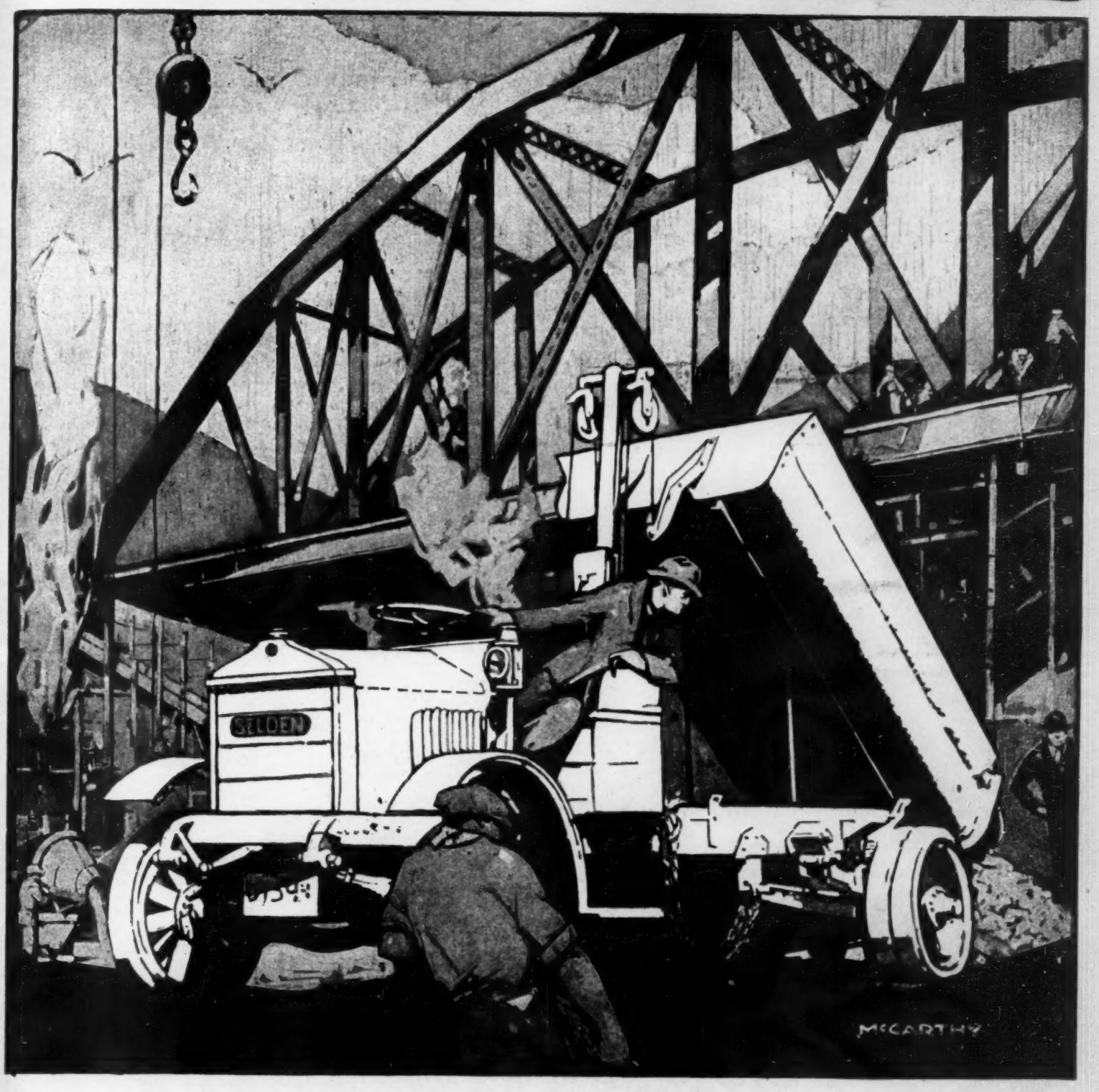

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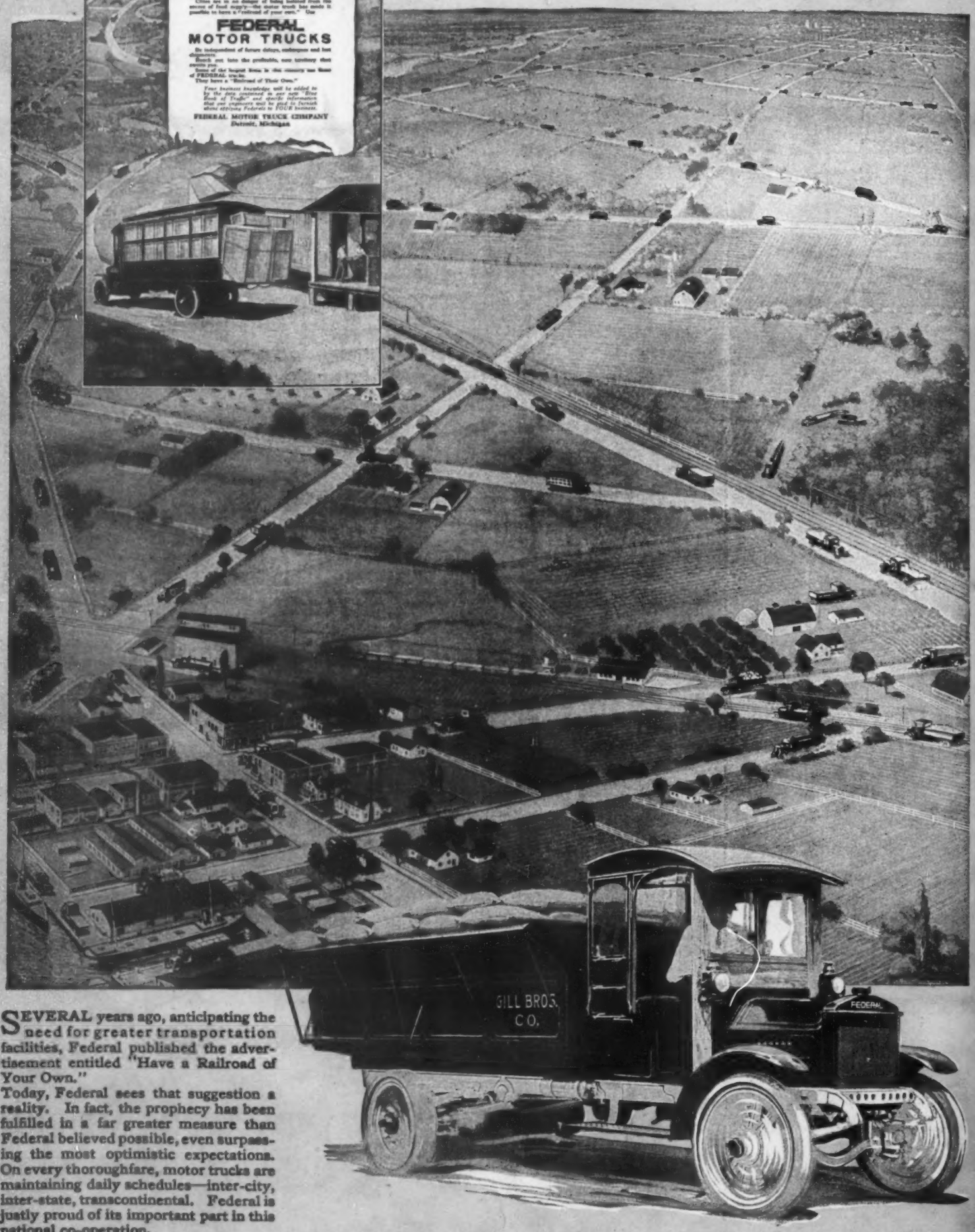

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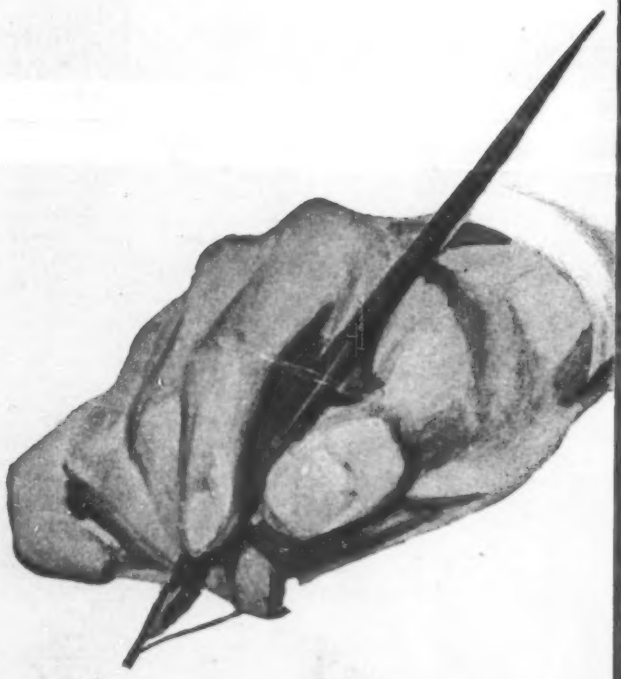

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